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# NEW TAXA

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## FOSSIL MAMMALS FROM MONTANA

## Pt. 2. Rodents from the Early Oligocene Pipestone Springs

## Local Fauna

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HARVARD  
UNIVERSITY

This is the second in a series of papers reviewing materials in the Carnegie Museum collections of vertebrate fossils from Tertiary localities in Montana. I would like to thank C. Lewis Gazin of the United States National Museum, M. C. McKenna of the American Museum of Natural History, and W. D. Turnbull of the Chicago Natural History Museum, for the loan of material in their care. Carnegie Museum field parties were able to make later collections through the generous support of the Childs Frick Corporation. The illustrations are by Mr. Clifford J. Morrow and were made possible by a grant from the Gulf Oil Corporation.

The first collection of fossil vertebrates from the Pipestone Springs locality near Whitehall, Montana, was made by Earl Douglass in 1899; and the first specimens were described by him in 1901. Included in this first paper on the Pipestone Springs fauna were descriptions of three new rodents: *Cylindrodon fontis*, *Sciurus jeffersoni*, and *Eumys minor*. Matthew (1903) added three new rodent species to the fauna: *Ischyromys veterior*, *Sciurus (Prosciurus) vetustus*, and *Gymnoptychus minimus*, all collected in 1902 by parties from the American Museum of Natural History. Burke (1935) described a new cylindrodontid, *Pseudocylindrodon neglectus*, from the fauna; and Wood (1937), in his monograph of the White River rodents, included descriptions of all species known from Pipestone Springs and recorded the presence of *Ischyromys pliacus* in the fauna. McGrew (1941) reported the occurrence of *Heliscomys* at Pipestone Springs; and Donohoe (1956), the most recent author to name a rodent from the assemblage, described *Pipestoneomys bisulcatus*.

A review of this rich fauna has not been undertaken since Matthew's

contribution in 1903, and the rodents have not been reviewed since Wood's paper in 1937. In recent years, collecting has been done at Pipestone Springs by a number of institutions. The largest collections are those made by J. LeRoy Kay for Carnegie Museum and by Jean Hough and C. Lewis Gazin for the United States National Museum. That restudy of these collections would contribute significantly to our knowledge is shown by the fact that prior to this report 69 rodent specimens representing 10 species had been described or mentioned in the literature, and of these 41 represented *Ischyromys-Titanotheriomys*. There are now in the Carnegie Museum collections alone 335 specimens of rodents representing all previously described species plus two new genera and one new species of eomyids, bringing the total number of rodent species known from Pipestone Springs to 13. They are:

	No. of Specimens CM Coll.
Family PARAMYIDAE	
<i>Prosciurus vetustus</i> Matthew	8
Family ISCHYROMYIDAE	
<i>Titanotheriomys veterior</i> (Matthew) }	143
<i>Ischyromys pliacus</i> Troxell }	
Family CYLINDRODONTIDAE	
<i>Cylindrodon fontis</i> Douglass	75
<i>Pseudocylindrodon neglectus</i> Burke	8
Family ?SCIURIDAE	
<i>?Protosciurus jeffersoni</i> (Douglass)	3
Family ?CASTORIDAE	
<i>Pipestoneomys bisulcatus</i> Donohoe	1
Family EOMYIDAE	
<i>Adjidaumo minimus</i> (Matthew)	3
<i>Paradjidaumo minor</i> (Douglass)	86
<i>Yoderimys burkei</i> , new species	1
<i>Namatomys lloydi</i> , new genus and species	2
<i>Aulolithomys bounites</i> , new genus and species	2
Family HETEROMYIDAE	
<i>Heliscomys</i> cf. <i>H. vetus</i> Cope	3

To the best of my knowledge all of the material used for this report was collected from the "Main Pocket" (which lies to the northwest of the old golf course, S.29, T.2N., R.5W., Jefferson Co., Montana) at

JAN 29 1965

Pipestone Springs. No material has been included that is known to have been collected from the Little Pipestone locality south of U.S. Highway 105 or from exposures north of the railroad tracks. Matthew (1903) was the first to recognize that the exposures to the north of the railroad were probably, at least in part, of Orellan age. There is also a possibility that sediments younger than those at the main locality are present in the Little Pipestone area. For this reason only specimens from the classic Pipestone Springs locality have been used and these are believed to be from a single unit fauna of Chadronian age.

Of the seven families of rodents found at Pipestone Springs, six were previously known from the early Oligocene, with only the Sciuridae here being tentatively recorded from the Chadronian for the first time. *Pipestoneomys bisulcatus* was described as an aplodontid by Donohoe (1956), and recently Alf (1962) has suggested castorid affinities for this species. As discussed later, the evidence is equivocal for its inclusion in either family, but to avoid further confusion in the literature it is here retained in the ?Castoridae with the strong possibility that the genus may well prove to belong in neither the Aplodontidae nor the Castoridae. One rodent family known to occur in the early Oligocene, the Eutypomyidae, has not been recognized in the Pipestone Springs fauna. The Eutypomyidae are well represented in certain early Oligocene faunas; but with the exception of a single  $P_4$  (Wood, 1937: 233) from Thompson Creek, Montana, members of this family are not known to occur outside the Great Plains area. It is possible, therefore, that at least in the early Oligocene, *Eutypomys* was restricted to the plains and did not live in the intermontane areas.

Three rodent species particularly abundant in the collections are *Titanotheriomys veterior*, *Cylindrodon fontis*, and *Paradjidaumo minor*, and these evidently lived in the immediate area of deposition. *Ischyromys pliacus*, *Prosciurus vetustus*, and *Pseudocylindrodon neglectus*, while not as abundantly represented as the above three, are present in numbers which suggest that they lived close to, if not in, the immediate area. *Adjidaumo minimus* and *Heliscomys vetus* are extremely small forms and the paucity of individuals collected to date could reflect a collecting bias rather than actual rareness in the deposit. The remaining five species are medium to large-sized forms and their rare occurrence in the fauna is probably not the result of sampling error but rather may indicate that these animals lived at some distance from the area of deposition.

Konizeski (1961) has suggested a similarity of early Oligocene en-



vironment for the Douglass Creek, Canyon Ferry, and Pipestone Springs basins, with each basin containing a central lake surrounded by marshland which is in turn ringed by upland coniferous forests. In this type of situation more abundant forms were probably lake border species, with the rare species possibly inhabiting the upland forest areas.

The following abbreviations are used throughout: AMNH, American Museum of Natural History; CNHM, Chicago Natural History Museum; CM, Carnegie Museum; USNM, United States National Museum; YPM, Yale Peabody Museum; a-p, anteroposterior; tr. transverse.

All measurements are in millimeters. When two transverse measurements are given, the first is the width across the protoloph or metalophid, and the second is the width of the metaloph or hypolophid.

#### SYSTEMATIC REVIEW

##### Family PARAMYIDAE Miller and Gidley, 1918 Genus *Prosciurus* Matthew

##### *Prosciurus vetustus* Matthew Figure 1

*Sciurus (Prosciurus) vetustus* Matthew, 1903.

*Prosciurus vetustus* Matthew, 1910.

TYPE: AMNH 9626, partial left maxilla with  $P^3-M^3$ .

HYPODIGM: CM 9785,  $LP^4$ ; CM 10111, fragment of left maxilla with  $P^3-M^1$ ; CM 10115, fragment of left maxilla with  $M^1-M^3$ . CNHM PM 8615, partial left maxilla and internal wall of orbit and infraorbital foramen with  $P^3-M^3$ . CM 9828, partial right mandible with  $P_4-M_3$ ; CM 9870, partial right mandible with  $P_4-M_3$ ; CM 10113, partial right mandible with  $M_1-M_2$ ; CM 10116, partial right mandible with  $P_4-M_3$ . CNHM PM 8612, partial right mandible with  $P_4-M_3$ . CNHM UM 405, partial right mandible with  $dP_4-M_2$ .

EMENDED DIAGNOSIS: Double metaconules on  $P^4-M^3$ ; upper cheek teeth wider than in *Prosciurus relictus*; hypolophids on  $P_4-M_3$  not as long as in *P. relictus*; width of  $M_1-M_2$  equals length.

DESCRIPTION: The upper cheek teeth have been described (Matthew, 1903, and Wood, 1937) and only a few details need be added here. The protocone on  $P^4-M^3$  is constricted anteroposteriorly and rises to a sharp peak. The metaloph on  $P^4-M^2$  is constricted and fuses with the protocone well down its internal face. Prominent mesostyles are present on  $P^4-M^3$  and are set off from the paracone and metacone by a narrow valley.

The mandible and lower dentition have not been previously described for this species. In structure and general proportions the mandible

resembles that of *Prosciurus relictus*, with a short diastema, little or no depression of the dorsal surface anterior to  $P_4$ , and a deep and heavy body under  $P_4$ - $M_3$ . The mental foramen lies about halfway down the side of the mandible midway between  $P_4$  and the incisor. The masseteric fossa terminates under the middle of  $M_1$ , and the dorsal and ventral ridges are strongly developed.

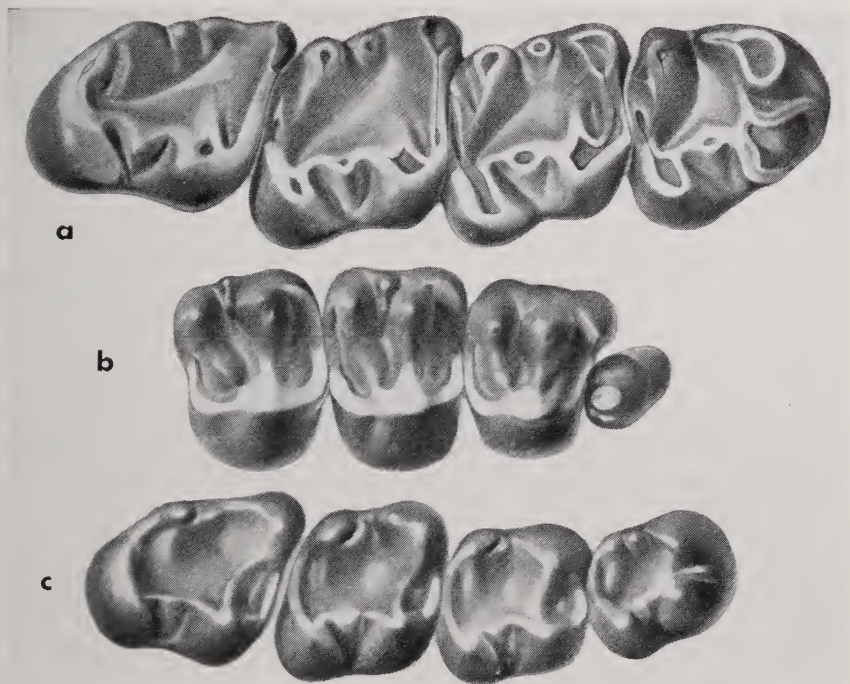


Fig. 1 a. *Prosciurus vetustus*, CM 9870,  $RP_4$ - $M_3$ ,  $\times 13\frac{1}{2}$ . b-c. *?Prosciurus jeffersoni*, b. CM 10112,  $RP_3$ - $M_2$ ,  $\times 6\frac{1}{2}$ . c. CM 736, Type,  $RP_4$ - $M_3$ ,  $\times 7$ .

The anterior half of  $P_4$  is partially compressed transversely, but the protoconid and metaconid are completely separated by a distinct trigonid basin. The mesoconid is large, filling most of the buccal valley on  $P_4$  and on  $M_1$ - $M_3$ . The mesostylid on  $P_4$  is fused into the posterior border of the metaconid; on  $M_1$ - $M_2$  it is a large and distinct cusp. The hypolophid on  $P_4$  is very short and curves into the posterolophid; on  $M_1$ - $M_2$  it is slightly longer but also merges with the posterolophid. The width of  $M_1$  and  $M_2$  equals the length, and the teeth are rhomboidal in outline. There is no distinct anterior cingulum on  $M_1$ - $M_3$ ; the lophid which

forms the anterior border of the teeth passes directly across the crown from the center of the metaconid to the antero-internal corner of the protoconid. The metaconid on  $M_1$ - $M_3$  lies at the extreme antero-internal corner of the teeth and does not curve back over the talonid basin. The metalophid is complete on  $M_1$  and the trigonid basin is thus closed posteriorly; on  $M_2$ - $M_3$  the basin is open with the metalophid incomplete.  $M_3$  is elongate antero-posteriorly with an expanded hypoconid and posterolophid.

## MEASUREMENTS IN MILLIMETERS

		No. of Specimens	Mean	Observed Range
Alveolar length	$P_4$ - $M_3$	4	8.1	7.9-8.2
Length of diastema		4	3.6	3.3-4.0
Depth below $M_1$		4	5.6	4.8-6.0
$P^3$	a-p	2	.75	.7- .8
	tr.	2	.85	.8- .9
$P^4$	a-p	3	1.73	1.7-1.8
	tr.	3	2.17	2.1-2.2
$M^1$	a-p	4	1.71	1.7-1.8
	tr.	4	2.35	2.3-2.5
$M^2$	a-p	3	1.73	1.7-1.8
	tr.	3	2.35	2.3-2.5
$M^3$	a-p	2	1.90	1.9
	tr.	2	2.10	2.0-2.2
$dP_4$	a-p	1	—	1.54
	tr.	1	—	1.25
	tr.	1	—	1.43
$P_4$	a-p	4	1.87	1.7-2.0
	tr.	4	1.54	1.5-1.6
	tr.	4	1.83	1.8-1.9
$M_1$	a-p	5	1.77	1.7-1.9
	tr.	5	1.82	1.7-1.9
	tr.	5	1.88	1.8-2.0
$M_2$	a-p	5	1.88	1.8-2.0
	tr.	5	2.02	1.9-2.1
	tr.	5	2.02	1.9-2.1
$M_3$	a-p	4	2.22	2.2-2.3
	tr.	4	1.99	1.9-2.1
	tr.	4	1.77	1.6-1.9
$I$	a-p	3	2.11	2.0-2.1
	tr.	3	1.53	1.5-1.6

Alveolar length  $P^3$ - $M^3$  CNHM PM 8615 7.3



**AFFINITIES:** *Prosciurus vetustus* is the oldest species of the genus that is known from adequate material<sup>1</sup> and could have been ancestral to *P. relictus* of the Orellan, although the presence of double metaconules in the Chadron species might argue against such a derivation. In all other respects, however, the Pipestone Springs species is ideally suited for such an ancestral position. A lengthening of  $M_1-M_2$  and an increase in the development of the hypolophid on  $P_4-M_3$  are all that is needed to bring about such a transition. Likewise, *P. vetustus* could be close to the ancestry of *Cedromus wardi*. The short hypolophids are characteristic of both species, those in *Cedromus wardi* being slightly stronger than in *P. vetustus*. The primary difference between the two species lies in the anteroposteriorly elongate  $M_1-M_2$  and, as in *P. relictus*, in the presence of only single metaconules on  $P^1-M^3$  in *Cedromus*.

The ancestry of *Prosciurus vetustus* is unknown. Wood (1962: 226) included the late Eocene *Mytonomys* in the subfamily Prosciurinae but stated that *Mytonomys* was certainly not ancestral to *Prosciurus* or to any other known member of the subfamily.

#### Family ISCHYROMYIDAE Alston, 1876

The ischyromyids *Titanotheriomys veterior* and *Ischyromys pliacus* are treated only briefly in this review. Both have been previously reported from this fauna, and in the Carnegie Museum collections there are 143 specimens representing these two species. In the course of this study, however, it became apparent that it is next to impossible to assign most of the material with any degree of confidence, even when dealing with complete dentitions, to one genus or the other as they are presently understood. After examining other material assigned to *Ischyromys typus* and *I. pliacus*, both Orellan forms, and also specimens of *Titanotheriomys wyomingensis* from Beaver Divide, Wyoming, several other problems regarding ischyromyid systematics have come to light. These problems can only be resolved by a thorough review of all the Oligocene ischyromyid material. For these reasons, while both species are listed below, no attempt has been made to add to the information supplied by Wood (1937: 188-191, 193-197). No formal diagnoses have ever been given for either *Ischyromys pliacus* or *Titanotheriomys veterior* and none are attempted here.

<sup>1</sup> *P. saskatchewaensis* and *P. aff. lohiculus*, both from Cypress Hills (Wood, 1937), are each known from only a single tooth and hence can offer little information for phylogenetic interpretation.

Genus *Ischyromys* Leidy*Ischyromys pliacus* Troxell*Ischyromys pliacus* Troxell, 1922.TYPE: YPM 12511, right mandible with P<sub>4</sub>-M<sub>3</sub>.Genus *Titanotheriomys* Matthew*Titanotheriomys veterior* (Matthew)*Ischyromys veterior* Matthew, 1903.*Ischyromys* (*Titanotheriomys*) *veterior* Matthew, 1910.*Titanotheriomys veterior* (Matthew), Miller and Gidley, 1920.LECTOTYPE: AMNH 9658, left mandible with P<sub>4</sub>-M<sub>3</sub>.

## Family CYLINDRODONTIDAE Miller and Gidley, 1918

Genus *Pseudocylindrodon* Burke*Pseudocylindrodon neglectus*

## Figure 2

*Cylindrodon fontis* Matthew, 1903, in part.*Pseudocylindrodon neglectus* Burke, 1935.TYPE: USNM 13758, partial left mandible with P<sub>4</sub>-M<sub>3</sub>.

HYPODIGM: CM 10100, incomplete skull. USNM 13757, left mandible with P<sub>4</sub>-M<sub>3</sub>; USNM 13759, right mandible with P<sub>4</sub>-M<sub>1</sub>. AMNH 9644, left mandible with dP<sub>4</sub>-M<sub>3</sub>; AMNH 9646, partial right mandible with P<sub>4</sub>. CM 9325, right mandible with M<sub>2</sub>-M<sub>3</sub>; CM 10007, right mandible with P<sub>4</sub>-M<sub>3</sub>; CM 10011, right mandible with P<sub>4</sub>-M<sub>3</sub>; CM 10027, left mandible with P<sub>4</sub>-M<sub>3</sub>; CM 10042, RM<sub>2</sub>-M<sub>3</sub>; CM 10091, right mandible with M<sub>1</sub>-M<sub>3</sub>; and CM 10096, left mandible with P<sub>4</sub>-M<sub>3</sub>, all mandibles incomplete.

EMENDED DIAGNOSIS: Near size of *Pseudocylindrodon medius*, cheek teeth higher crowned; anterior cingulum on P<sup>1</sup> short, fused with antero-internal face of paracone; mesostyle present on P<sup>1</sup>-M<sup>2</sup>; no hypolophid crest on P<sub>4</sub>; mesostylid fused to posterior metaconid slope on P<sub>4</sub>-M<sub>3</sub>; central and posterior basins closed internally on M<sub>1</sub>-M<sub>3</sub>; hypoconid, hypolophid and posterior cingulum reduced on M<sub>3</sub>.

DESCRIPTION: The skull fragment agrees in most respects with the corresponding parts of *Pseudocylindrodon medius*, differing only in a few details. *P. neglectus* differs from *P. medius* in the greater expansion of the premaxilla at the premaxillary-frontal contact with the result that the dorsal expansion of the maxilla is reduced. The lacrimal may

have been somewhat larger in *P. neglectus* but its exact extent is impossible to determine due to breakage. The sphenopalatine foramen is not as elongate antero-posteriorly and is directed more vertically in *P. neglectus* than in *P. medius*. The posterior narial opening is narrow, more as in *Cylindrodon* than in *P. medius*, and is carried farther forward than in the latter species. In size and general proportions *P. neglectus* is nearly identical with *P. medius*.

The mandible is short, deep, and rather heavy, with a short diastema. In general it is very similar to that of *P. medius* but is deeper below the cheek teeth. Two mental foramina are present, one lying below the anterior root and the other below the posterior root of  $P_4$ . The masseteric fossa extends forward to below the anterior end of  $M_2$ . Neither the dorsal nor ventral masseteric ridges are prominent, and the fossa is not constricted anteriorly but terminates in a broad curve.

The upper incisors have a greater antero-posterior than transverse diameter and are ovate in cross section. The anterior face is rounded and the enamel is limited to the anterior surface. The pulp cavity is angulate.

The upper dentition of *P. neglectus* has not previously been known. The skull fragment, CM 10100, has the complete dentition, with the exception of  $RP^3$ , preserved in a moderately worn condition. In *P. neglectus*  $P^3$  is a more slender tooth than it is in *P. medius* but in both species it is a simple peg with no trace of accessory cusps or cingula such as are seen in *Ardynomys*. The fourth upper premolar and  $M^1$ - $M^2$  are of nearly equal size and are broadly triangular, while  $M^3$  is much smaller and oval in occlusal view. As in *Cylindrodon* and *Ardynomys*  $P^4$ - $M^3$  are unilaterally hypsodont. Wear has obliterated any trace of the reduced hypocone, the condition described by Burke (1938: 268) for *P. medius*.

On  $P^4$  the anterior cingulum is extremely short and fails to open on the buccal margin of the tooth but bends back into the base of the paracone. A small shallow pit is thus formed between the anterior cingulum and the protoloph. In *P. medius* the anterior cingulum is much longer and reaches the buccal margin of  $P^4$ , with the basin between the cingulum and protoloph opening buccally. The protoloph and metaloph are complete on  $P^4$ . There is no protoconule but the metaconule is large and fuses with the posterior cingulum. Two small pits are thus formed between the posterior cingulum and metaloph. The central basin opens to the buccal margin but this opening is partially constricted by a prominent mesostyle situated at the base of the paracone.

The first and second upper molars are essentially identical in structure. The anterior cingulum reaches the buccal border and the anterior basin is open. The central basin is only partially closed by a large mesostyle in both teeth. The connection of the metaconule and posterior cingulum can be seen on  $M^2$ , but wear has obliterated any traces of this crest on  $M^1$ . The posterior cingulum is short and meets the posterior side of the metacone internal to the buccal margin of the tooth.

The third molar is considerably smaller than  $M^1$ - $M^2$ , due partially to its unworn condition but also to a reduction in the size of the protocone, metaloph, metaconule and posterior cingulum. The latter elements are greatly compressed with metaconule-metacone appearing almost as a single cusp. A small pit is cut off between the metaloph, metaconule and posterior cingulum but the buccal end of the posterior cingulum does not fuse with the metacone as it does on  $M^1$ - $M^2$ . The anterior cingulum reaches to the buccal side of  $M^3$  as it does in  $M^1$ - $M^2$ . No mesostyle is present on  $M^3$ .

The lower incisor is oval in cross section, with a rounded anterior face. The posterior border is more constricted than in the upper incisor but the two agree fairly closely in outline. The enamel is for the most part confined to the anterior face, overlapping only slightly onto the lateral margins of the tooth. The pulp cavity is long and narrow.

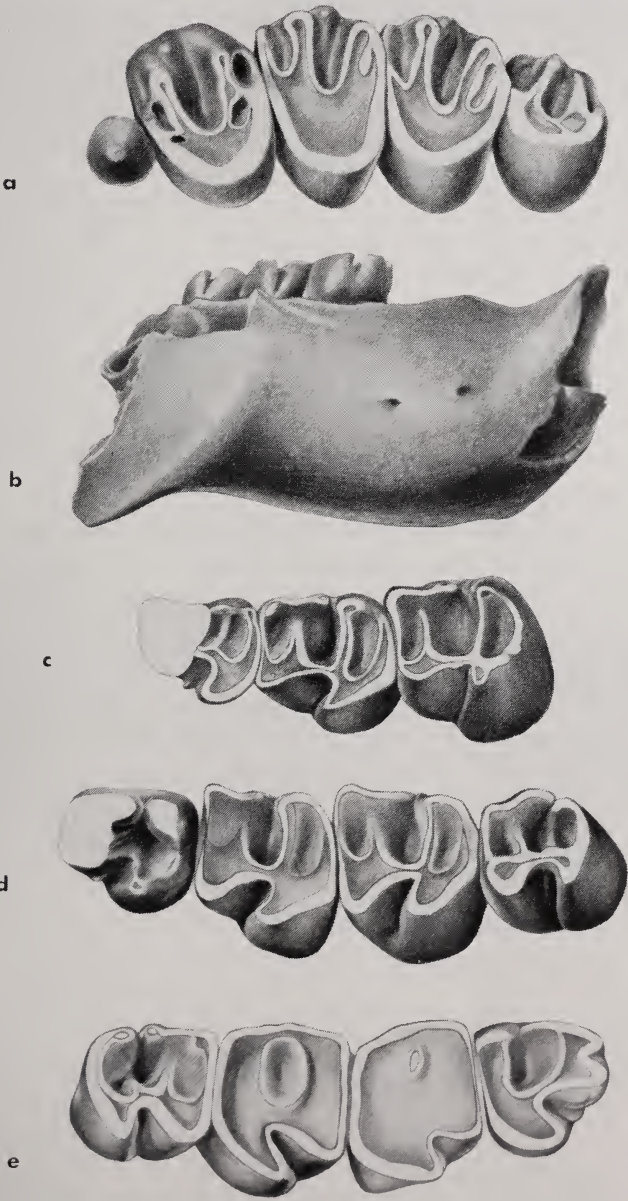
In AMNH 9644 the anterior half of the crown of  $dP_4$  is broken, but enough of the tooth is preserved to show the presence of a well developed hypolophid passing from the entoconid to the antero-internal corner of the hypoconid. This crest is absent in the permanent premolar of *P. neglectus* but is well developed in  $P_4$  of *P. medius*.

The lower cheek teeth are higher crowned than are those of *P. medius* but agree closely with that species in size and general shape. The anterior half of  $P_4$  is narrow, with the protoconid and metaconid closely appressed and separated by only a shallow groove on the anterior face of the tooth. The mesostylid is fused into the posterior slope of the metaconid, as it is on  $M_1$ - $M_3$ , forming a crest which sweeps back to join the entoconid and thus completely cuts off the central basin. In *P. medius* the mesostylid is absent and the central valley opens on the lingual

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Fig. 2 *Pseudocylindrodon neglectus*. a. CM 10100,  $LP^3$ - $M^3$ ,  $\times 10$ . b. CM 10091, right mandible,  $\times 5$ . c. AMNH 9644,  $LdP_4$ - $M_2$ , Type,  $\times 10$ . d. CM 10096,  $LP_4$ - $M_3$ ,  $\times 10$ . e. CM 10007,  $RP_4$ - $M_3$ ,  $\times 10$ .





margin of  $P_4$ - $M_3$ . The hypoconid on  $P_4$  is strongly developed but there does not appear to be any hypoconulid.

The lower molars are similar in structure, although  $M_3$  is much smaller than  $M_1$ - $M_2$  and has a reduced hypocone, hypolophid, and posterior cingulum. In all three teeth the metalophid is well developed and with the anterior cingulum isolates a very shallow trigonid pit between the protoconid and metaconid. The central basin is deep but is obliterated at advanced wear stages; the anterior and posterior basins disappear at a much earlier wear stage. The hypolophid on  $M_1$ - $M_2$  is strongly developed but is weak to absent on  $M_3$ . The hypoconulid is not distinct as a separate cusp on  $M_1$ - $M_2$  but the buccal end of the posterior cingulum where it meets the hypoconid is enlarged. The cingulum passes from this area across and up to fuse with the entoconid near the top of the cusp. On  $M_3$  the hypoconid and posterior cingulum are reduced in size and there is no enlargement of the buccal end of the posterior cingulum.

**AFFINITIES:** *Pseudocylindrodon neglectus*, while sharing some features such as mesodont cheek teeth and double mental foramina with *P. medius* from the early Oligocene of McCarty's Mountain, differs from that species in the possession of mesostyles and stylids, the absence of a hypolophid crest on  $P_4$ , and the almost complete closure internally of the transverse valleys on  $P_4$ - $M_3$ . Neither species of *Pseudocylindrodon* could be directly ancestral to *Cylindrodon fontis*, their contemporary, but *P. medius* seems to be closer to *Cylindrodon* than is *P. neglectus*. The absence of mesostyles on  $P^4$ - $M^3$  and the presence of a hypolophid on  $P_4$  would tend to support this conclusion. *P. neglectus*, so far as is now known, left no descendants.

#### MEASUREMENTS IN MILLIMETERS

##### CM 10100

Alveolar length $P^3$ - $M^3$	7.0	$M^2$ a-p	1.7
$P^3$ a-p	.7	tr.	2.4
tr.	1.0	$M^3$ a-p	1.4
$P^4$ a-p	1.6	tr.	1.9
tr.	2.5	$I^1$ a-p	1.9
$M^1$ a-p	1.7	tr.	1.8
tr.	2.5		

		AMNH 9325	CM 10007	CM 10011	CM 10027	CM 10091	CM 10096
Alveolar length	P <sub>4</sub> -M <sub>3</sub>	7.6	7.2	7.2	7.3	7.5	7.3
Length of diastema		3.1	3.4	—	3.5	3.3	3.2
Length below M <sub>1</sub>		—	5.8	5.5	5.7	5.4	5.3
P <sub>4</sub>	a-p	—	1.6	—	—	—	—
	tr.	—	1.8	1.8	—	—	—
M <sub>1</sub>	a-p	—	1.6	1.6	—	1.7	1.7
	tr.	—	2.2	2.1	—	2.1	2.1
M <sub>2</sub>	a-p	1.8	1.7	1.7	—	1.8	1.8
	tr.	2.1	2.1	2.1	—	2.1	2.1
M <sub>3</sub>	a-p	1.6	1.7	1.6	—	1.6	1.6
	tr.	1.8	1.7	—	—	1.7	1.8
I <sub>1</sub>	a-p	2.1	—	—	2.0	—	—
	tr.	1.9	—	—	1.7	—	—

### Genus *Cylindrodon* Douglass

#### *Cylindrodon fontis* Douglass

#### Figure 3

#### *Cylindrodon fontis* Douglass, 1901

**LECTOTYPE:** CM 738a, partial left mandible with M<sub>1</sub>-M<sub>3</sub>. Douglass (1901: 251) did not designate a type but mentioned two specimens, Nos. 38 and 39, and figured No. 38. These numbers referred to his own personal collection. When the specimens were turned over to Carnegie Museum they were re-numbered 738 and 738a. Wood (1937: 202) designated 38 (CM 738) as the type. This specimen has since been lost. Therefore CM 738a, Douglass' second syntype (39), is here designated the lectotype.

**REFERRED SPECIMENS:** 75 specimens in the Carnegie Museum collections and numerous specimens in the AMNH, CNHM, and USNM collections.

**EMENDED DIAGNOSIS:** Cheek teeth hypsodont; dP<sup>3</sup> present but P<sup>1</sup> displaces dP<sup>3</sup>-dP<sup>4</sup>, leaving only four teeth in permanent dentition; anterior and posterior basins of dP<sup>4</sup>, M<sup>1</sup>-M<sup>2</sup> completely enclosed, and central basins open buccally only during earliest wear stages; no anterior basin on P<sup>4</sup> and anterior cingulum absent; posterior basin of P<sup>4</sup> enclosed and divided by short ridge from metaloph to posterior cingulum; M<sup>1</sup>-M<sup>3</sup> much longer than wide when unworn, becoming wider than long with wear; dP<sub>4</sub> narrow, elongate, with strong hypolophid and discrete anterior cingulum; P<sub>4</sub> shorter, more robust, without anterior cingulum; anterior and posterior basins enclosed on M<sub>1</sub>-M<sub>2</sub>; M<sub>1</sub>-M<sub>3</sub> longer than wide when unworn, becoming nearly cylindrical with wear.

**DESCRIPTION:** Known parts of the skull of *Cylindrodon fontis* agree well with those of *Pseudocylindrodon*. The rostrum is short and broad. The nasal-frontal and premaxillary-frontal sutures lie slightly farther

behind the anterior end of the orbit in *C. fontis* than they do in *Pseudocylindrodon*, and the premaxillary-frontal contact is rather broad. The infra-orbital foramen lies higher on the face than it does in *Pseudocylindrodon*, and the ventral surface of the zygoma is broader and more deeply excavated in *C. fontis*. The posterior palatine notch lies opposite the middle of  $M^2$ .

The mandible is short and heavy, having a very short diastema. The single mental foramen is anterior to  $P_4$  and just below the alveolar level. The masseteric fossa is delimited by strong dorsal and still stronger ventral masseteric ridges which meet below the anterior edge of  $M_2$ . The ascending ramus rises rather steeply from a point opposite the anterior end of  $M_2$ , but in none of the available material from Pipestone Springs is more than the root of the ascending ramus preserved.

The upper incisors are oval in cross section with the enamel limited to the rounded anterior faces. The pulp cavity is short and narrow.

Both upper and lower cheek teeth are hypsodont. The unilateral hypsodonty seen in *Pseudocylindrodon* is only slightly developed in *Cylindrodon*, where there is almost no difference in crown height between the buccal and lingual margins of the upper teeth and only a slight difference in the lower dentition. When unworn and through the early wear stages the crowns of  $M^1$ - $M^3$  and  $M_1$ - $M_3$  are considerably longer than they are wide. In the upper molars the antero-posterior dimension decreases with wear while the transverse dimension increases until the teeth are wider than long. Coinciding with these changes in the upper molars, the occlusal outline of the lower molars changes from rectangular to cylindrical.

In the upper dentition  $dP^3$  is present as pointed out by Wood (1937: 201), but it is shed along with  $dP^4$  with the eruption of the permanent premolar. The deciduous  $P^3$  is a small, very simple peg-like tooth with only a single conical cusp and no trace of cingula. The deciduous  $P^4$  resembles  $M^1$ - $M^2$  in most respects, differing primarily in possessing a more compressed posterior cingulum.

When unworn the occlusal outline of the permanent premolar is nearly square. There is a wide lingual border which shows no distinct cusps, a short metaloph with distinct metaconule, and a narrow posterior cingulum that joins the metacone below the level of the metaloph. Anteriorly, the paracone and lingual shelf are separated by a narrow trench. The paracone is bulbous and there is no indication of a distinct protoloph. With wear the paracone and internal shelf are joined, but the narrow valley between the two cusps remains as a trench for a considerable



distance down the anterior face of the tooth. Posteriorly, there are generally two small ridges running from the metaconule to the posteroloph. In advanced wear stages the premolar takes on the rectangular occlusal outline of  $M^1-M^2$ .

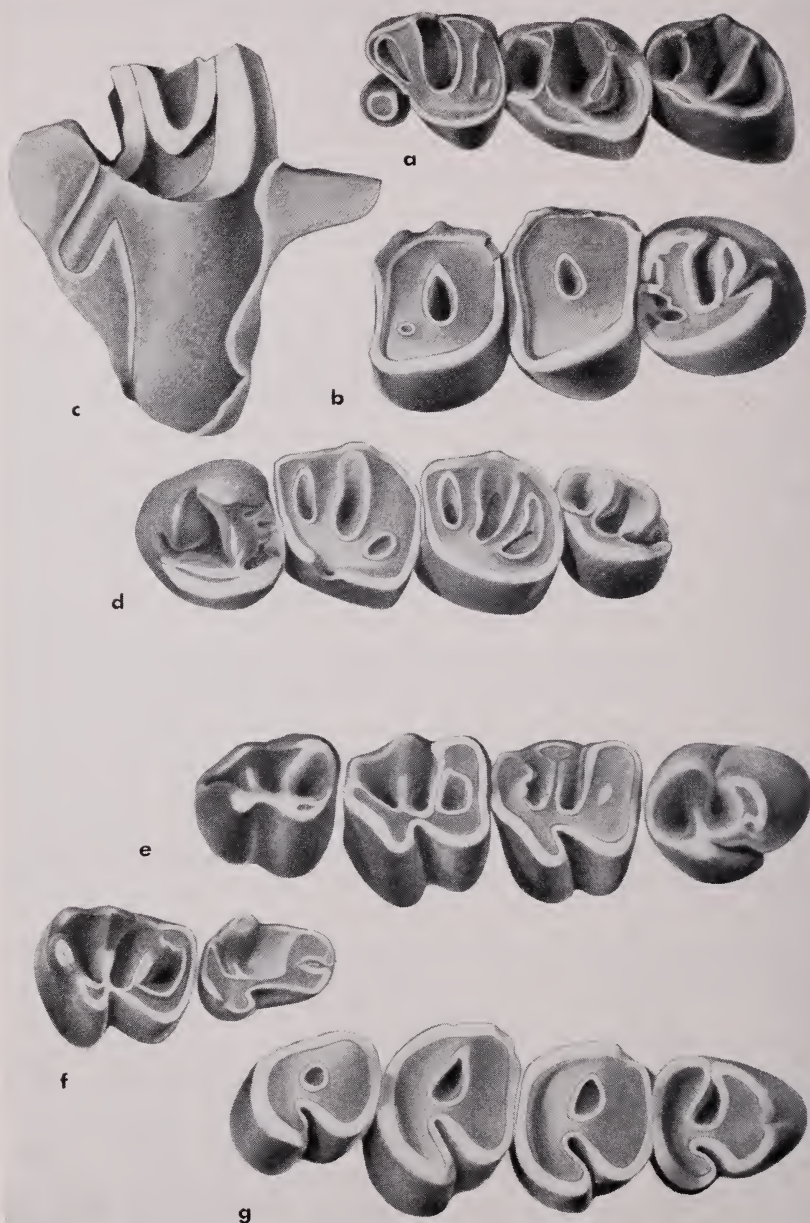
Unworn  $M^1-M^2$  display four transverse lophs which enclose three basins. The anterior and posterior basins are not as deep as the central basin and are completely enclosed even in unworn teeth. The central basin is open at the buccal margin during early wear stages but is closed by the time  $dp^3-dp^4$  are shed. The internal borders of  $M^1-M^2$  are quite long in young individuals but neither the protocone nor hypocone can be distinguished as discrete cusps. The crowns taper toward the base of the molars with a reduction in the width of the anterior and posterior cingula and the anterior and posterior basins. This tapering, coupled with the migration of the wear surface internally, results in the extreme change in occlusal dimensions of  $M^1-M^2$  and to a lesser degree of  $P^4$  and  $M^3$ . The last element of the crown pattern to be lost on all teeth is the enamel fossette of the central basin. These changes in shape and pattern are shown in figure 3, as is a vertical section of  $M^1$  showing the construction and depth of the central basin.

The third upper molar, smallest of the upper cheek teeth, shows a considerable reduction of the posterior half of the crown. The anterior cingulum, protoloph, and metaloph resemble those in  $M^1-M^2$  but are much shorter. At early stages of wear the posterior basin is open to the rear of the tooth and the well developed posteroloph seen on  $M^1-M^2$  is absent, as is the expanded postero-internal corner of the crown. With wear the posterior basin is closed by a loph which swings in an arc from the protocone to the rear of the metacone.

The lower incisors are triangular in cross section, with the enamel limited to the rounded anterior face. The pulp cavity is narrow and short.

The deciduous lower premolar is long and slender and is wider posteriorly than anteriorly. A narrow fissure separates the protoconid and metaconid partway down the crown, but with moderate wear these two cusps become fused. The hypolophid consists of only a small, short spur which passes from the hypoconid across to the base of the entoconid. The posterolophid and entoconid are set off at early wear stages by a shallow cleft but with greater wear are fused into a continuous posterolophid.

The permanent lower premolar is shorter and broader than  $dp_4$ . The protoconid and metaconid, even when  $P_4$  is essentially unworn, are



fused into a single anterior column, with the trigonid basin indicated by a very shallow, ephemeral pit. The central basin is deep and almost completely enclosed, with only a shallow slit between the metaconid and entoconid. The hypolophid rises to the occlusal surface and is strongly developed. The posterior cingulum curves from the hypoconid to the entoconid and, with the hypolophid, cuts off a deep posterior basin.

At early stages of wear  $M_1$ - $M_2$  are longer than wide due to the angular expansion of the hypoconulids and posterior cingula at the crown surface. The posterior cingula terminate well behind the entoconids, where they are met by buttresses from the posterior edge of the entoconids which close off the posterior basins. With wear the posterior borders of  $M_1$ - $M_2$  become rounded, with the posterior cingula swinging in an arc to the posterior corners of the entoconids and the occlusal outlines taking on a circular appearance. Anteriorly, there is a small trigonid basin cut off by the anterior cingulum and metalophid. This is the shallowest of the three basins and disappears early in the life of the tooth. The central basin is narrow but deep. Along the lingual borders of  $M_1$ - $M_2$  the metaconid and entoconid are fused into a continuous ridge after little wear, although at the earliest wear stages they are separated by a very narrow trench.

The third lower molar is the smallest of the cheek teeth and here, as in  $M^3$ , the reduction has been primarily in the posterior elements of the crown. The trigonid resembles that of  $M_1$ - $M_2$ , but, in the talonid, the hypolophid is very short as is the posterior cingulum. The shallow posterior basin is lost rapidly with wear.

**AFFINITIES:** Only two species of *Cylindrodon* are known, *Cylindrodon fontis* and *C. nebraskensis* Hough and Alf from the Chadron of northwestern Nebraska. The latter species was based on one jaw with badly worn dentition. From the description (Hough and Alf, 1956) this species can not be distinguished from *C. fontis*, and I believe that it may be synonymous with *C. fontis*. However, I have refrained here from synonymizing it with *C. fontis* as the Nebraska fauna is now under study by A. E. Wood, who has more material from this cylindrodont population.

Wood (1937: 203, figs. 29 and 30) figured and briefly described some

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Fig. 3 *Cylindrodon fontis*. a. CM 8904,  $LdP^3-M^2$ ,  $\times 10$ . b. CM 9223,  $RP^4-M^2$ ,  $\times 10$ . c. CM 10106, longitudinal section of  $LM^1$  showing depth of central fossette,  $\times 10$ . d. CM 10030,  $LP^4-M^3$ ,  $\times 10$ . e. CM 10009,  $RP_4-M_3$ ,  $\times 10$ . f. CM 10104,  $RdP_4-M_1$ ,  $\times 10$ . g. CM 10012,  $RP_4-M_3$ ,  $\times 10$ .

specimens from Beaver Divide, Wyoming, which he listed as *Cylindrododon*, new species. Examination of these specimens, one of which shows  $dP^3$ - $dP^4$  and another  $dP_4$ , along with one or more unworn molars, leads me to consider them a population of *C. fontis*. The characters which are listed as differing from those of *C. fontis*, such as position of mental foramen, narrow  $M_3$  talonid, molariform  $dP_4$ , and straight metalophid, are all duplicated in the Pipestone Springs population.

*Cylindrododon fontis* was evidently an end line of the Cylindrodontidae in North America. It was a widespread species in the early Oligocene, being known from Nebraska, Montana, and Saskatchewan and several localities in Wyoming. No specimens have been reported from later horizons.

## MEASUREMENTS IN MILLIMETERS

	Number of Specimens	Mean	Standard Deviation	Coefficient of Variation	Observed Range
Alveolar length $P^1$ - $M^3$	6	7.1	—	—	6.5-7.5
Alveolar length $P_4$ - $M_3$	22	7.7	.31	4.03	7.2-8.5
Length of diastema	16	3.4	.30	8.82	3.0-4.0
Depth below $M_1$	21	6.1	.29	4.75	5.7-6.6
$dP^3$ a-p	2	.75	—	—	.7- .8
tr.	2	.85	—	—	.8- .9
$dP^4$ a-p	3	1.77	—	—	1.7-1.8
tr.	3	1.70	—	—	1.5-1.8
$P^4$ a-p	6	1.73	—	—	1.6-2.0
tr.	6	2.03	—	—	1.6-2.7
$M^1$ a-p	9	1.86	—	—	1.5-2.1
tr.	9	1.99	—	—	1.5-2.7
$M^2$ a-p	9	1.78	—	—	1.5-2.0
tr.	9	1.78	—	—	1.3-2.4
$M^3$ a-p	5	1.56	—	—	1.4-1.7
tr.	5	1.46	—	—	1.2-1.7
$I^1$ a-p	2	1.75	—	—	1.5-2.0
tr.	2	1.80	—	—	1.5-2.1
$dP_4$ a-p	4	1.87	—	—	1.7-2.0
tr.	4	1.53	—	—	1.4-1.7
$P_4$ a-p	21	1.77	.010	5.65	—
tr.	21	1.71	.048	8.65	—



		Number of Specimens	Mean	Standard Deviation	Coefficient of Variation	Observed Range
M <sub>1</sub>	a-p	24	1.87	.125	6.68	1.6-2.2
	tr.	24	1.97	.150	7.61	1.6-2.3
M <sub>2</sub>	a-p	24	1.82	.108	5.93	1.6-2.0
	tr.	24	1.95	.150	7.69	1.6-2.2
M <sub>3</sub>	a-p	22	1.64	.086	5.24	1.4-1.8
	tr.	22	1.45	.142	9.79	1.1-1.6
I <sub>1</sub>	a-p	12	2.03	—	—	1.8-2.2
	tr.	12	1.87	—	—	1.8-2.0

## Family ?SCIURIDAE Gray, 1821

Genus *Protosciurus* Black? *Protosciurus jeffersoni* (Douglass)

## Figure 2

*Sciurus jeffersoni* Douglass, 1901.

*Prosciurus jeffersoni* (Douglass), Matthew, 1909.

? *Prosciurus jeffersoni* (Douglass), Wood, 1937.

*Cedromus jeffersoni* (Douglass), Wood, 1962.

TYPE: CM 736, partial right mandible with P<sub>4</sub>-M<sub>3</sub>.

HYPODIGM: Type and CM 9329, partial right mandible with P<sub>4</sub>-M<sub>3</sub>; CM 10112, fragment of right maxilla with P<sup>3</sup>-M<sup>2</sup>. CNHM UM 406, partial left mandible with P<sub>4</sub>-M<sub>1</sub>.

EMENDED DIAGNOSIS: Masseteric fossa terminating under hypoconid of M<sub>1</sub> with small muscle scar immediately anterior to fossa; P<sup>4</sup>-M<sup>2</sup> with low lophs and little or no indication of conules; protocone slightly anterior in position, with strong internal protocone-posterior cingulum connection; M<sub>1</sub>-M<sub>2</sub> wider than long; entoconid corners of M<sub>1</sub>-M<sub>2</sub> slightly rounded; trigonid basins on M<sub>1</sub>-M<sub>3</sub> enclosed; no separation between entoconid and posterolophid on P<sub>4</sub>-M<sub>2</sub> but entoconids rise above level of posterolophid; short hypolophid from entoconids into talonid basins of P<sub>4</sub>-M<sub>3</sub>; mesostylids small on P<sub>4</sub>-M<sub>2</sub>, slightly larger on M<sub>3</sub>.

DESCRIPTION: There is no proof for association of the mandible of ?*P. jeffersoni* and the upper dentition here referred to the species. The two are of the same size and occlude well, however; and there is no other rodent known in the fauna to which the maxillary fragment could be assigned. Also, since both the upper and lower teeth show a number of resemblances to sciurid dentitions, I believe association of the two is likely.

The third upper premolar is a round, stout peg lying just internal to

the expanded anterior cingulum and parastyle of  $P^4$ . A small lingual shelf is developed part way down the slope of the single cusp on  $P^3$ , but the shelf is not carried onto the anterior face of the tooth.  $P^4$ - $M^2$  are massive teeth with large protocones and low lophs. Expansion of the buccal portion of the anterior cingulum on  $P^4$  gives the occlusal surface of the tooth a triangular outline. On  $M^1$ - $M^2$  the width of the cingulum remains constant, giving the teeth a rectangular occlusal outline. The posterior cingula on  $P^4$ - $M^2$  are narrow and do not reach the buccal margins of the teeth. Lingually, however, the cingula are broad where they bend anteriorly to join the protocones. This condition is pronounced in  $M^1$ - $M^2$ , not as well developed on  $P^4$ . The protoloph and metaloph on  $P^4$ - $M^2$  are low and are fused to the buccal slope of the protocone. Neither protoconules nor metaconules can be distinguished with any certainty within the lophs; but the metalophs, particularly on  $M^1$ - $M^2$ , are partially constricted at the protocone. There is a small mesostyle between the paracone and metacone on  $M^1$ - $M^2$ , but there is no mesostyle on  $P^4$ .

The mandible is heavy with a short diastema and shallow depression between  $I_1$  and  $P_4$ . The mental foramen lies slightly anterior to  $P_4$  and considerably below the dorsal surface of the mandible. The masseteric fossa extends forward to below the hypoconid of  $M_1$ ; anterior to this point a shallow scar extends forward to below the middle of  $M_1$ . The deeply concave masseteric fossa has a strong dorsal ridge and a gently curved anterior border.

$P_4$ - $M_2$  are of approximately equal length, but the premolar is considerably narrower, especially across the trigonid. The trigonid basin on  $P_4$  is reduced to a narrow, anteroposteriorly directed slit which is open at both ends. A small elongate anteroconid passes from the protoconid forward to the anterior margin of the tooth. The large trigonid basins on  $M_1$ - $M_3$  are completely enclosed. The anterior cingulum is thick and on  $M_1$  is so swollen as to appear cusp-like. The metalophid is complete on all molars. The apex of the metaconid on  $P_4$ - $M_3$  is directed buccally and overhangs the trigonid basin. This cusp is also elongate, with its postero-lingual margin drawn out into a buttress which is separated from the entoconid by a narrow valley partially filled by a small mesostylid. The entoconid on  $P_4$ - $M_3$  rises above the level of the posterolophid but is completely incorporated within the lophid. The posterior borders of  $P_4$ - $M_2$  curve slightly from the entoconid to the hypoconid. On  $M_3$  the posterolophid is expanded posteriorly, making the tooth much longer than  $P_4$ - $M_2$  and the posterolophid

much heavier than in the anterior teeth. There is a short hypolophid on all the cheek teeth which is directed toward the hypoconid but which fades into the talonid basin about one-third of the distance across the crown. The ectolophid is low and dominated by a small but distinct mesoconid. The buccal valley is wide and deep with the ectolophid set well in from the buccal margin.

The incisor is large but compressed transversely as in sciurids. The enamel is finely wrinkled and covers the anterior and one-quarter of the lateral face. The pulp cavity is slit-like.

## MEASUREMENTS IN MILLIMETERS

		CM 10112	CM 736	CM 9329	CNHM UM 406
Alveolar length	P <sub>4</sub> -M <sub>3</sub>	—	12.7	13.2	—
P <sup>3</sup>	a-p	1.1	—	—	—
	tr.	1.5	—	—	—
P <sup>4</sup>	a-p	2.7	—	—	—
	tr.	3.6	—	—	—
M <sup>1</sup>	a-p	2.9	—	—	—
	tr.	3.9	—	—	—
M <sup>2</sup>	a-p	2.9	—	—	—
	tr.	3.8	—	—	—
P <sub>4</sub>	a-p	—	2.7	2.7	2.7
	tr.	—	2.4-2.7	2.3-2.6	2.2-2.6
M <sub>1</sub>	a-p	—	2.7	2.9	2.7
	tr.	—	2.9-3.1	3.0-3.1	2.6-2.8
M <sub>2</sub>	a-p	—	2.8	3.1	—
	tr.	—	3.2-3.2	3.4-3.3	—
M <sub>3</sub>	a-p	—	3.6	3.8	—
	tr.	—	3.3-3.0	3.6-3.1	—
I <sub>1</sub>	a-p	—	—	—	3.5
	tr.	—	—	—	2.0

AFFINITIES: *?Protosciurus jeffersoni* has had a checkered taxonomic history, having been referred to three different genera since its description by Douglass (1901). Its most recent reference previous to this study was to *Cedromus* (Wood, 1962).

Before discussing the relationships of *?P. jeffersoni* it should be point-

ed out that there is some question as to whether the skull referred to ?*Cedromus* sp., in which the only upper dentition known for the genus is preserved, is actually referable to that genus (Galbreath, 1953: 59, and Wood, 1962: 233). Galbreath thought the association likely, however, and I agree. I also believe that the skull is probably that of *Cedromus wardi* on the basis of occlusal relationships. As stated earlier, there is no definite basis for assuming the upper dentition here referred to ?*P. jeffersoni* is associated with the type mandible; however, all available evidence suggests such an association and I believe the maxilla is that of ?*P. jeffersoni*.

If these associations prove to be correct, the dentition of ?*Protosciurus jeffersoni* differs from that of *Cedromus wardi* in the following respects: (1) rectangular occlusal outline of  $M^1$ - $M^2$  effected by the anteroposterior expansion of the protocone and the broad connection of the posterior cingulum and protocone; (2) low lophs on  $P^4$ - $M^2$ ; (3) absence of protoconules and metaconules on  $P^4$ - $M^3$ ; (4) greater transverse than anteroposterior dimensions of  $M_1$ - $M_2$ ; (5) strong anterior cingulum on  $M_1$ - $M_3$ ; (6) entoconid partially incorporated in posterolophid on  $P_4$ - $M_3$ ; (7) buccal valleys of  $P_4$ - $M_3$  not filled by mesoconid and ectostylid; (8) posterolophid of  $M_3$  greatly expanded.

In characters (1), (5), and (8) ?*Protosciurus jeffersoni* differs from *Cedromus wardi*. The difference between the two species in characters (6) and (7) are ones of degree and here ?*P. jeffersoni* more closely resembles the sciurids than it does *Cedromus*. This suite of characters also distinguishes ?*Protosciurus jeffersoni* from *Prosciurus vetustus*, *P. relictus* and *Pelycomys*. The only real point of similarity between ?*Protosciurus jeffersoni* and the prosciurines *Cedromus*, *Prosciurus*, and *Pelycomys* lies in the presence of a hypolophid on  $P_4$ - $M_3$  in the Pipestone Springs species and in all prosciurines. In ?*Protosciurus jeffersoni* this is a very small structure; in *Cedromus wardi* and *Prosciurus vetustus* it is stronger; and in *Prosciurus relictus* and *Pelycomys* it is still more strongly developed. Although a hypolophid is not known to occur in any sciurid before the late Miocene (Black, 1963b), it is possible that it was present in the early history of the family. The dental similarities between ?*Protosciurus jeffersoni* and *Protosciurus mengi* from the Orellan of Nebraska, and the distinct differences between ?*Protosciurus* Springs species as provisionally referable to the Sciuridae. If ?*Protosciurus jeffersoni* and the prosciurines, have led me to consider the Pipestone *sciurus jeffersoni* proves to be a sciurid it represents the oldest record for the family.



Family ?CASTORIDAE Gray, 1821

Genus *Pipestoneomys* Donohoe

*Pipestoneomys bisulcatus* Donohoe

*Pipestoneomys bisulcatus* Donohoe, 1956.

TYPE: CNHM UM 409, partial right maxilla with M<sup>1</sup>-M<sup>3</sup>.

HYPODIGM: CNHM UM 408, partial right mandible with dP<sub>4</sub>-M<sub>1</sub> and CM 10047, partial left mandible with P<sub>4</sub>-M<sub>1</sub>.

DIAGNOSIS: "Cheek teeth high crowned, rooted, lacking prominent styles or stylids. M<sup>1</sup> and M<sup>2</sup> approximately equal in size, quadrangular; M<sup>3</sup> smaller, subcircular. Hypocone and protocone of M<sup>1</sup> and M<sup>2</sup> subequal, separated by a deep persistent groove. Deep groove separating anteroloph and paracone. Trigonid and talonid separated by a deep persistent groove, mesoconid well developed." (Donohoe, 1956: 264).

DESCRIPTION: The upper dentition has been thoroughly described by Donohoe. Consequently only certain features of the mandible and of P<sub>4</sub>, material which was not available to him, will be described here.

The mandible is shallow but very thick below P<sub>4</sub>-M<sub>1</sub>. The masseteric fossa terminates under the midpoint of P<sub>4</sub> and its anterior border is rounded. The mental foramen lies immediately anterior to P<sub>4</sub> and about one-third of the way down the side of the jaw.

The incisor is triangular in cross section with a short, slit-like pulp cavity. Enamel is restricted to the slightly convex anterior face of the tooth. P<sub>4</sub>-M<sub>1</sub> are badly worn in CM 10047, and little of the crown pattern is preserved. At this stage of wear P<sub>4</sub> shows two isolated lakes, one antero-internal, the other postero-internal, and a prominent buccal reentrant which persists to the base of the crown. P<sub>4</sub> is longer than is M<sub>1</sub>.

#### MEASUREMENTS IN MILLIMETERS

CM 10047					
P <sub>4</sub>	a-p	2.1	M <sub>1</sub>	a-p	1.7
	tr.	1.9		tr.	1.8

AFFINITIES: *Pipestoneomys* was originally referred to the Aplodontidae (Donohoe, 1956), but recently, Alf (1962) while describing a new species of *Pipestoneomys*, *P. pattersoni*, has tentatively suggested castorid affinities for the genus. The absence of P<sup>3</sup> in *P. pattersoni*, as discussed by Alf, would tend to remove *Pipestoneomys* from the Aplodontidae, as would a number of characters seen in the upper dentition. However, the complete absence of any lingual folds on P<sub>4</sub> and M<sub>1</sub> argues

against castorid affinities, as does the absence of a hypoflexus in the upper cheek teeth.

The reference of *Pipestoneomys* to the ?Castoridae is extremely dubious and the genus will probably prove to be referable to neither the Aplodontidae nor the Castoridae. However, until more is known of this form it is here retained in the ?Castoridae, primarily to avoid further confusion in the literature.

#### Family EOMYIDAE Depéret and Douxami, 1902

Five species of eomyids occur in the Pipestone Springs fauna. The relationships of these forms to each other and to other late Eocene and early Oligocene members of the family are considered below after the systematic section.

#### Genus *Adjidaumo* Hay

#### *Adjidaumo minimus* (Matthew)

Figures 5e, 6b

*Gymnoptychus minimus* Matthew, 1903.

*Adjidaumo minimus* Wood, 1937.

TYPE: AMNH 9625, left mandible with  $P_4$ - $M_3$ , angle, condyle and coronoid process missing.

REFERRED SPECIMENS: CM 9213, partial right mandible with  $P_4$ - $M_2$ ; CM 9214, partial right mandible with  $P_4$ - $M_3$ ; CM 10135,  $LP_4$ - $M_2$ .

DIAGNOSIS: Smaller than *Adjidaumo minutus*, near size of *A. douglassi*;  $P_4$ - $M_3$  lower crowned than in *A. douglassi* with loph not as high and prominent; posterior cingulum shorter and more compressed than in *A. douglassi*.

DESCRIPTION: The mandible is long and slender with the length of the diastema about one-quarter shorter than the length of the tooth row. The mental foramen lies anterior to  $P_4$  and almost on the dorsal surface of the mandible. Below the posterior end of  $P_4$  the masseteric fossa ends rather acutely in a large prominence. The dorsal masseteric ridge is stronger than the ventral and rises gently to the ascending ramus which originates opposite the posterior half of  $M_2$ . There is a prominent, elevated cap well up the lateral face of the ascending ramus marking the pulp cavity of the incisor much as in geomyids.

The lower incisor is compressed transversely with rounded anterior and lateral faces. The enamel extends just over the medial margin while laterally it covers half of the side of the tooth. The pulp cavity is narrow.

The protoconid and metaconid of  $P_4$  are of equal size and are joined posteriorly by a short crest. The anterior valley between the cusps is open. In the four specimens available there is considerable variation in the transverse extent of the mesolophid. In the type and in CM 10135 the mesolophid is short and merges into the internal base of the metaconid while in CM 9214 it reaches almost to the lingual border and is free. In CM 9213 the mesolophid meets the base of the metaconid, where it is joined by a short crest from the lingual border, which may represent an elongate mesostylid although no trace of this cusp can be seen in any of the other specimens available. The ectolophid of  $P_4$  is short, and there is no indication of a mesoconid. The posterior cingulum is extremely short, arising from the midpoint of the hypolophid and fading into the postero-internal base of the entoconid.

The molars present more or less the same crown pattern as the premolars, with  $M_1$ - $M_2$  being of nearly equal size and  $M_3$  smaller. The anterior cingulum is joined to the base of the metaconid and by a short crest to the metalophid where the latter leaves the protoconid. The buccal end of the cingulum is free. The mesolophid is longer on  $M_2$  and  $M_3$  than on  $M_1$  in the type and CM 10135, but it is of the same length on  $M_1$ - $M_2$  in CM 9213 and CM 9214. In the type the mesolophids are free at their lingual ends, but in the other specimens they reach the base of the entoconids. The posterior cingulum is better developed on  $M_1$  than on  $M_2$  and is absent on  $M_3$ . As a result the valley between the posterior cingulum and entoconid is wider on  $M_1$  than on  $M_2$ .

## MEASUREMENTS IN MILLIMETERS

		AMNH 9625	CM 9213	CM 9214	CM 10132
Alveolar length	$P_4$ - $M_3$	3.6	3.8	3.8	4.2
Length of diastema		3.0	3.0	3.0	3.0
Depth below $M_1$		2.6	—	—	2.8
$P_4$	a-p	.8	.8	.8	.8
	tr.	.7- .8	.6- .7	.6- .8	.7- .8
$M_1$	a-p	.9	1.0	1.0	.9
	tr.	.9- .9	.9- .9	.9- —	.9- .9
$M_2$	a-p	.9	1.0	1.0	.9
	tr.	1.0- .9	1.0-1.0	1.0-1.0	1.0- .9
$M_3$	a-p	.9	—	.9	—
	tr.	.9- .7	—	.8- .8	—
$I_1$	a-p	.9	—	—	—
	tr.	.6	—	—	—

Genus *Paradjidaumo* Burke*Paradjidaumo minor* (Douglass)

## Figure 4

*Eumys minor* Douglass, 1901

*Gymnoptychus minor* (Douglass), Matthew, 1903.

*Adjidaumo minor* (Douglass), Hay, 1930.

*Paradjidaumo minor* (Douglass), Burke, 1934.

TYPE: CM 735, a partial right mandible with  $P_4$ - $M_1$ .

REFERRED SPECIMENS: Eighty-six specimens in the collections of Carnegie Museum and numerous other specimens in the AMNH, USNM, and CNHM collections.

DIAGNOSIS: Somewhat smaller than *P. trilophus*; cheek teeth lower crowned; anterior cingulum of  $M_1$ - $M_3$  not as closely appressed to metalophid; mesolophid generally long, reaching lingual border of  $P_4$ - $M_3$ .

DESCRIPTION: There is only one skull fragment in the present collection which can be assigned to *P. minor*. The anterior portion of the skull is preserved from the posterior alveolar border forward and agrees in most details with the condition described by Wilson (1949) for a skull of *P. trilophus*. There is a rather large, shallow depression above the infraorbital foramen and passing forward to the premaxillary-maxillary suture from which a portion of the *masseter lateralis* probably arose. Prominent premaxillary ridges are also present lateral to the incisors. The maxillary-palatine suture lies somewhat farther forward in *P. minor* than in *P. trilophus*, terminating opposite the middle of  $P_4$  in the Pipestone Springs species. In other details the skull of *P. minor* appears identical to that of *P. trilophus*.

The cheek teeth of *Paradjidaumo* are mesodont, showing in relation to other eomyids an increase in the height of the cross lophs and lophids as well as increase in height of cusps. The teeth of *P. minor* are somewhat less advanced in this character than are those of *P. trilophus* but the difference is not great. There is considerable variation in occlusal pattern in the Pipestone Springs material, particularly in  $P^1_4$  and  $M^3_3$ .

The fourth upper premolar is essentially molariform, differing from  $M^1$ - $M^2$  primarily in the absence of the anterior cingulum. In CM 9231, however, there is a very shallow, compressed pocket on the anterior face of the paracone which is bounded anteriorly by what is probably a short anterior cingulum that fades into the anterior face of the paracone. This pit would be obliterated with further wear. In other unworn specimens such as CM 8979 (fig. 4e), and in all other worn specimens



there is no trace of an anterior cingulum. The mesoloph on  $P^4$  is variable in length, reaching across the crown surface to the mesostyle in CM 9231 but ending in the center of the crown in CM 8979 and CM 9896. The valley between the metaloph and posterior cingulum is moderately deep and these elements become fused into a single loph only after considerable wear.

The first upper molar is the largest of the cheek teeth but it differs only slightly from  $M^2$  in crown pattern. The anterior cingulum is distinct on both  $M^1$ - $M^2$  when the teeth are unworn, but it quickly merges with the protoloph as wear proceeds. The posterior cingulum remains distinct somewhat longer but it also eventually fuses with the metaloph, producing the "Omega" pattern. The mesoloph joins a short spur from the mesostyle to form a complete loph across the center of  $M^1$  in all the specimens available. In  $M^2$ , however, the mesoloph does not reach the mesostyle in CM 8979 so that no complete central loph is formed. In some specimens the two elements are joined in the unworn state, while in others they become fused only after moderate wear has occurred.

The third upper molar is the smallest of the upper cheek teeth and the crown elements are reduced. The protocone and paracone are the largest cusps and they are joined by a strong protoloph. The anterior cingulum is short and is confined to the buccal quarter of the anterior face of the tooth. The elements behind the protoloph are variable in their development. In CM 9231 the hypocone and metacone are distinct and moderately large and there is a small lingual valley between the protocone and hypocone. In CM 8979 the hypocone and metacone are small and there is only a faint cleft between the lingual cusps. In CM 8979 there is a well developed mesoloph passing from the postero-internal corner of the protocone obliquely across the crown to a large mesostyle; while in CM 9271 the mesoloph is shorter and arises from the midpoint of the metaloph, passing anteriorly and then buccally to the mesostyle. The posterior cingulum is generally very short.

The superior incisors are transversely compressed, ungrooved, and have slightly rounded anterior and lateral faces. The pulp cavity is a short, narrow slit.

The mandible of *Paradjidaumo* is larger but of the same type as that of *Adjidaumo*. It is long and slender with a V-shaped masseteric fossa extending forward under  $P_4$ , a long diastema, mental foramen lying high on the side of the jaw midway between the incisor and premolar, and a pronounced rounded expansion on the lateral side of the ascending ramus marking the pulp cavity of the incisor. The condyle lies above

the tooth row, is elongate antero-posteriorly, and faces upward and outward.

The deciduous lower premolars are more slender than  $P_4$ , but in other details the teeth agree fairly closely. The trigonid is higher than the talonid, with the protoconid and metaconid closely appressed and joined by a very short posterior protoconid arm. A short anterior cingulum is present in some specimens and absent in others. When present it drops sharply from the anterior face of the protoconid to merge into the base of the metaconid. In some specimens a distinct trigonid pit is isolated between the anterior cingulum and protoconid arm, while in others the trigonid basin is open anteriorly. The length of the mesolophid is also variable. In many specimens it reaches the lingual margin while in some it passes only three-quarters of the way across the crown. The presence or absence of a posterior cingulum is also variable but when present it is short. The hypolophid passes from the entoconid to the posterolophid rather than to the hypoconid.

When unworn,  $M_1$  and  $M_2$  show a five-crested pattern which changes with wear to a three-crested pattern. The anterior cingulum is longer than the posterior and set off more distinctly from the metalophid than the posterior cingulum is from the hypolophid. As in the premolar, the length of the mesolophid is variable but it always passes at least halfway across the occlusal surface. The posterior elements of  $M_3$  are reduced through the lateral compression of the hypoconid and entoconid and the loss of the posterior cingulum.

The lower incisors are transversely compressed and have flat anterior and convex lateral faces. There is a low ridge along the lateral margin of the external face. The enamel extends about halfway up the lateral face. The pulp cavity is slit-like.

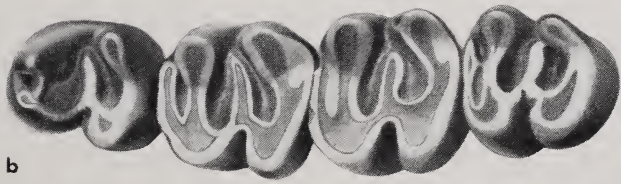
#### MEASUREMENTS IN MILLIMETERS

		Number of Specimens	Mean	Standard Deviation	Coefficient of Variation	Observed Range
Alveolar length	$P^4-M^3$	4	5.2	—	—	4.7-5.8
Alveolar length	$P_4-M_3$	49	5.7	.34	6.0	5.2-6.6
Length of diastema		33	4.8	.40	8.3	4.0-6.0
Depth below $M_1$		53	3.8	.19	3.6	3.4-4.5

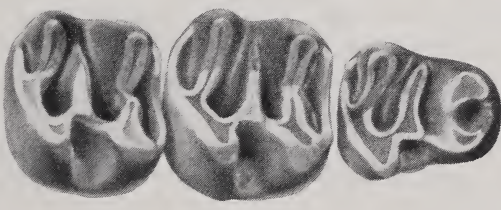
Fig. 4 *Paradjidaumo minor*. a. CM 10051, left mandible, x5. b. Same,  $LP_4-M_3$ , x15. c. CM 10041,  $RdP_4-M_2$ , x15. d. CM 9231,  $LP^4-M^3$ , x10. e. CM 8979,  $RP^4-M^3$ , x15.



a



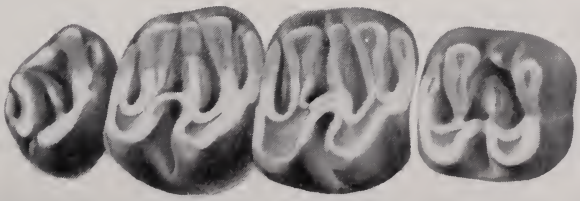
b



c



d



e

		Number of Specimens	Mean	Standard Deviation	Coefficient of Variation	Observed Range
P <sup>4</sup>	a-p	7	1.3	—	—	1.1-1.5
	tr.	7	1.4	—	—	1.2-1.6
M <sup>1</sup>	a-p	8	1.4	—	—	1.4-1.5
	tr.	8	1.6	—	—	1.4-1.7
M <sup>2</sup>	a-p	8	1.3	—	—	1.2-1.4
	tr.	8	1.6	—	—	1.6-1.7
M <sup>3</sup>	a-p	6	.9	—	—	.8-1.0
	tr.	6	1.3	—	—	1.2-1.4
I <sup>1</sup>	a-p	1	1.7	—	—	—
	tr.	1	1.0	—	—	—
P <sub>4</sub>	a-p	30	1.41	.11	3.6	1.1-1.6
	tr. metalophid	30	1.36	.12	8.8	1.0-1.5
	tr. hypolophid	30	1.05	.09	8.5	.9-1.3
M <sub>1</sub>	a-p	36	1.44	.09	6.1	1.3-1.6
	tr.	36	1.51	.91	6.0	1.3-1.7
M <sub>2</sub>	a-p	33	1.38	.07	4.9	1.2-1.5
	tr.	33	1.54	.08	5.4	1.4-1.7
M <sub>3</sub>	a-p	16	1.29	.14	11.0	1.1-1.5
	tr.	16	1.34	.08	6.0	1.2-1.5
I <sub>1</sub>	a-p	17	1.50	.03	1.8	1.3-1.6
	tr.	17	0.98	.02	1.6	0.9-1.0

### Genus *Yoderimys* Wood

#### *Yoderimys burkei*<sup>1</sup>, new species

##### Figures 5i, 6a

TYPE: CM 9782, partial left mandible with P<sub>4</sub>-M<sub>2</sub>, lacking ascending ramus and angle.

HYPODGM: Type only.

DIAGNOSIS: Larger than *Yoderimys bumpi*; mandible short, extremely heavy; diastema short, deep; cheek teeth brachydont; P<sub>4</sub> as large as M<sub>1</sub>-M<sub>2</sub>; anteroconid present on P<sub>4</sub>; anterior cingulum on M<sub>1</sub>-M<sub>2</sub> wide, free both buccally and lingually; long lophid passes from center of anterior cingulum to center of metalophid on M<sub>1</sub>-M<sub>2</sub>; mesolophid long, directed anteriorly to base of metaconid; hypolophid arises at antero-internal corner of hypoconid on P<sub>4</sub>-M<sub>2</sub>; posterior cingulum of P<sub>4</sub>-M<sub>2</sub> expanded.

<sup>1</sup> The specific name is given in honor of J. J. Burke for his work on early Oligocene rodents and rabbits.



DESCRIPTION: The jaw is short, deep and very heavy. Anterior to  $P_4$  the dorsal surface of the mandible drops rather steeply and then turns upward in a gentle slope to the rear of the incisor. The mental foramen lies below the anterior root of  $P_4$  about one-quarter of the way down the side of the ramus. The masseteric fossa ends in a semicircular depression below the contact of  $P_4$  and  $M_1$ , whereas in *Y. bumpi* it reaches somewhat farther forward. The dorsal masseteric crest cuts off this anterior depression from the main extent of the fossa as it passes obliquely down the lateral side of the ramus to fuse with the ventral ridge below the middle of  $M_1$ . Although most of the ascending ramus is missing it appears to arise much farther down on the side of the mandible than in other eomyids, with its anterior border rising well below  $M_2$ .

The cheek teeth are brachyodont. Although all are well worn so that most of the detail of the crown pattern is lost on the anterior half of  $P_4$ , the arrangement of the lophids is still plain on the posterior half of  $P_4$  and on  $M_1$ - $M_2$ . The anterior half of  $P_4$  is slightly compressed transversely. The lower premolars of *Y. bumpi* and *Y. burkei* are similar in most respects, but the anteroconid is smaller in *Y. bumpi*. It is connected to the protoconid by a narrow lophid but is completely separated from the metaconid. The protoconid-metaconid connections and the position of the mesolophid have been obliterated by wear, although there is some indication that the mesolophid passed obliquely forward to fuse with the base of the metaconid. The hypoconid on  $P_4$  lies somewhat behind the entoconid, and the cusps are joined by a lophid arising from the center of the entoconid and joining the anterior hypoconid arm where the latter meets the ectolophid. The posterior cingulum passes lingually to the base of the entoconid but fails to reach the lingual margin of  $P_4$ . The valley between the entoconid-hypolophid and the posterior cingulum is narrow and shallow. The buccal valley between the protoconid and hypoconid is wide and deep, with the ectolophid passing along the midline of the tooth.

The crown patterns of  $M_1$ - $M_2$  are essentially identical. The protoconids and hypoconids lie slightly behind the metaconids and entoconids so that the transverse lophids cross from the center of the lingual cusps to the anterior corners of the buccal cusps. The metalophids are stronger than in *Y. bumpi*. The ectolophid lies along the midline of  $M_1$ - $M_2$  as it does on  $P_4$  and is more internal in position than in *Y. bumpi*. The buccal valley is wide. The mesolophid passes to the base of the metaconid internal to the lingual margin of  $M_1$ - $M_2$  and is in general longer than in the Wyoming species. On both teeth the portion anterior to the

metalophid is expanded antero-posteriorly into a wide shelf, which is divided into buccal and lingual areas by a strong anteroposterior lophid. This lophid arises from the anterior face of  $M_1$ - $M_2$  and passes into the middle of the metalophid. The anterior border of  $M_1$ - $M_2$  is elevated into a thin transverse ridge which is somewhat stronger on  $M_2$ . The posterior cingulum is slightly elevated on  $M_1$ - $M_2$ , and fuses with the base of the entoconid, thus enclosing a rather wide valley between the cingulum and the hypolophid.

## MEASUREMENTS IN MILLIMETERS

CM 9782				
Length of diastema	5.6	$M_1$	a-p	2.3
Depth below $M_1$	5.8		tr.	1.8-1.9
$P_4$ a-p	2.3	$M_2$	a-p	2.3
tr.	1.7-2.0		tr.	2.0-2.0

**Namatomys**, new genus

Type species: **Namatomys**<sup>1</sup> **lloydi**<sup>2</sup>, new species

DIAGNOSIS: Near size of *Adjidaumo*; mandible short, deep; diastema short;  $P_4$  with small anteroconid; anterior cingulum free buccally on  $P_4$ - $M_3$ , joins anterior protoconid arm on  $M_1$ - $M_3$ ; anterior and posterior protoconid arms present on  $P_4$ - $M_3$ , both fused to base of metaconid; ectolophid long, set well in towards center of  $P_4$ - $M_3$ ; mesolophid very short, directed towards hypolophid; hypolophid passes to hypoconid on  $P_4$ , hypoconulid on  $M_1$ - $M_2$ ; posterior half of  $M_3$  only partially reduced.

**Namatomys lloydi**, new species

Figures 5c,d; 6d

TYPE: CM 8976, partial left mandible with  $P_4$ - $M_3$ , lacking ascending ramus, angle and part of incisor.

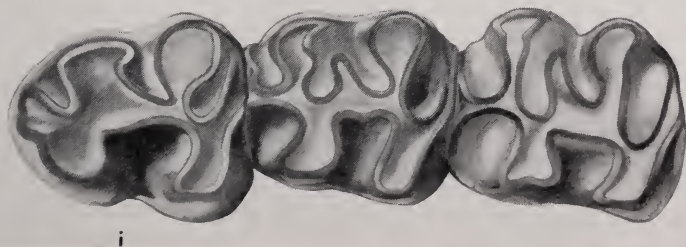
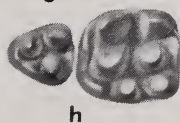
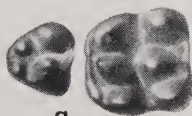
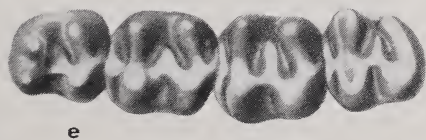
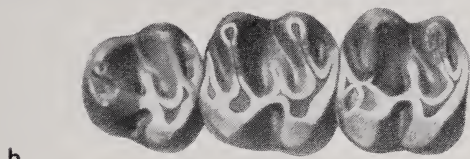
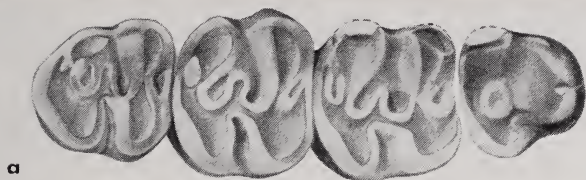
HYPODGM: Type and CM 10046, partial left ramus with  $P_4$ - $M_2$ .

DIAGNOSIS: Only known species of the genus.

<sup>1</sup> From Greek *nama*, *namatos*, spring or stream and *mys* mouse.

<sup>2</sup> The specific name is given in honor of Mr. A. C. Lloyd, who spent many seasons collecting with Dr. J. L. Kay at Pipestone Springs.

Fig. 5 a-b. *Aulolithomys bounites*, new genus and species. a. USNM 22825,  $RP_4$ - $M_3$ , x10. b. USNM 20974, Type,  $LP_4$ - $M_2$ , v10. c-d. *Namatomys lloydi*, new genus and species. c. CM 8976,  $LP_4$ - $M_3$ , Type, x10. d. CM 10046,  $LP_4$ - $M_2$ , x10. e. *Adjidaumo minimus*, AMNH 9625,  $LP_4$ - $M_3$ , Type, x15. f-h. *Heliscomys* cf. *H. vetus*, f. CM 9006,  $LP^4$ - $M^3$ , x15. g. CM 9230,  $LP_4$ - $M_1$ , x15. h. CNHM PM 8627,  $LP_4$ - $M_1$ , x15. i. *Yoderimys burkei*, new species. CM 9782,  $LP_4$ - $M_2$ , Type, x10.



**DESCRIPTION:** The mandible is short and deep with the diastemal length less than the alveolar length of  $P_4$ - $M_3$ . The anterior surface of the mandible drops abruptly anterior to  $P_4$  and then rises gently to the incisor alveolus with the anterior tip of the mandible lying at the same level as the  $P_4$ - $M_3$  alveoli. The mental foramen lies just below the dorsal border of the mandible and slightly anterior to  $P_4$ . The masseteric fossa is delimited by strong dorsal and ventral ridges and extends forward below the posterior half of  $P_4$ .

The lower incisors are compressed transversely and have rounded anterior and lateral faces. The enamel extends over about one-third of the lateral surface but does not overlap onto the medial side of the tooth. The pulp cavity is narrow and slit-like.

The cheek teeth are brachyodont with high principal cusps and low lophs; they are essentially equal in their anteroposterior dimensions but  $P_4$  is narrower than are  $M_1$ - $M_3$ . All of the teeth show the presence of two protoconid arms which pinch into the base of the metaconid, isolating a small, circular pit between the protoconid and metaconid. The strength of the anterior protoconid arm varies on  $P_4$  in the two specimens available, being stronger on the type than on CM 10046. On all cheek teeth the ectolophid is long and set in from the buccal margin about one-third of the distance across the tooth. The buccal valley is therefore deep and is squared off internally.

There is a small anterior cingulum on  $P_4$  which is better developed in CM 8976 than in CM 10046. The protoconid and metaconid are set close together, leaving only a very small pit isolated between the cusps and the protoconid arms. The mesolophid on  $P_4$  is extremely short in both specimens. The hypolophid arises at the postero-internal corner of the hypoconid and is directed slightly anteriorly to the corner of the entoconid. The posterior cingulum is short on  $P_4$ , failing to reach the lingual border of the tooth, and the valley between the hypolophid and posterior cingulum is very narrow.

Though nearly identical in crown pattern,  $M_1$ - $M_2$  differ in the shorter and more acutely angled hypolophid on  $M_2$ . On  $M_2$ , the hypolophid arises from the midpoint of the posterior border, while on  $M_1$  it arises much closer to the hypoconid. In both teeth the anterior cingulum reaches completely across the anterior face, fusing with the base of the metaconid internally but remaining free externally. The cingulum is connected to the anterior protoconid arm at the antero-internal corner of the protoconid. The mesolophid is very short on both  $M_1$ - $M_2$  but is slightly longer on  $M_2$  than on  $M_1$ .



The anterior half of  $M_3$  does not differ from the condition seen in  $M_1$ - $M_2$ , but there is some reduction in the posterior half of the tooth. The entoconid is not recognizable as a distinct cusp but is fused into a wide, heavy posterior ridge within which the hypolophid and posterior cingulum are also indistinguishable. The ectolophid is shorter on  $M_3$  and not as high as it is on  $M_1$ - $M_2$ . The mesolophid is longer on  $M_3$  than on  $M_1$ - $M_2$ .

## MEASUREMENTS IN MILLIMETERS

	CM 8976	CM 10046
Alveolar length $P_4$ - $M_3$	5.2	5.0
Length of diastema	—	3.7
Depth below $M_1$	3.8	3.8
$P_4$ a-p	1.3	1.3
tr.	1.0-1.1	1.0-1.1
$M_1$ a-p	1.4	1.4
tr.	1.3-1.3	1.3-1.3
$M_2$ a-p	1.4	1.4
tr.	1.4-1.4	1.3-1.3
$M_3$ a-p	1.3	—
tr.	1.3-1.1	—
$I_1$ a-p	—	1.5
tr.	—	0.9

*Aulolithomys*, new genus

Type species: *Aulolithomys*<sup>1</sup> *bounites*<sup>2</sup>, new species

DIAGNOSIS: Larger than *Adjidaumo*, *Paradjidaumo*, and *Namatomys*; smaller than *Centimanomys*; cheek teeth brachyodont;  $P_4$  compressed antero-posteriorly; metaconids and entoconids of  $M_1$ - $M_2$  set close together; molars not as elongate in relation to width as in other North American eomyids; anterior and posterior cingula short on  $P_4$ - $M_2$ ; when unworn, buccal end of anterior cingulum free on  $M_1$ - $M_2$ ; mesolophids short and low; metaconids elongate antero-posteriorly on  $P_4$ - $M_3$ .

*Aulolithomys bounites*, new species

Figures 5a,b;6c

TYPE: USNM 20974, left mandible with  $P_4$ - $M_2$ , missing  $M_3$ , angle, coronoid process, and condyle.

<sup>1</sup> From Greek *aulon*, os pipe, *lithos* stone, and *mys* mouse, pipestone mouse.

<sup>2</sup> From Greek *bounites*, dweller in the hills.

**HYPODIGM:** Type and USNM 22825, right mandible with worn  $P_4$ - $M_3$ . CM 9780, partial left mandible with  $P_4$ - $M_2$ , and CM 10099, fragment of left mandible with  $M_1$ .

**DIAGNOSIS:** Only known species of genus.

**DESCRIPTION:** The mandible resembles that of *Adjidaumo* and *Paradjidaumo* but is considerably larger than in those genera. The diastema is long, its length nearly equaling the alveolar length of  $P_4$ - $M_3$ . The mental foramen lies just below the dorsal surface of the diastemal portion of the mandible and just anterior of  $P_4$ . The masseteric fossa is deeply concave with prominent dorsal and ventral masseteric ridges. The ventral masseteric ridge extends forward under the anterior end of  $P_4$  and the dorsal ridge terminates below the anterior end of  $M_1$ , thus failing to join the ventral ridge and close the masseteric fossa anteriorly. The ascending ramus rises rather steeply beginning opposite the middle of  $M_2$ . The incisor pulp cavity forms a rounded prominence on the ascending ramus.

The lower incisor is compressed laterally with a nearly flat anterior face and a rounded lateral margin. The enamel covers half of the lateral surface and overlaps very slightly onto the medial side of the tooth. The pulp cavity is a short, narrow slit on the wear surface.

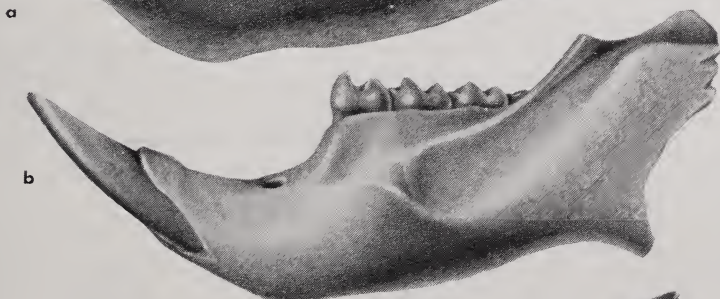
The fourth lower premolar is small, more so than in any eomyid other than *Rhodanomys* with which I am familiar. The protoconid and entoconid are separated by a very small, shallow trigonid basin, but with little wear they become fused into a single, heavy ridge. When unworn these cusps are joined by a short anterior cingulum and metalophid, which enclose the trigonid basin. There is a short, low mesolophid that fades into the talonid basin at the center of the tooth. The hypoconid and entoconid are united through the posterior cingulum. The hypolophid passes from the hypoconid to the midpoint of the posterior edge of the tooth where it meets an arm from the entoconid. The posterior cingulum proceeds lingually from this point to fuse with the posterior margin of the entoconid.

The first and second lower molars are subequal in size and rectangular in occlusal outline. When unworn the anterior cingulum was probably free at the buccal margin on each tooth, but this condition is seen

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Fig. 6 a. *Yoderimys burkei*, CM 9782, lateral view left mandible, Type,  $\times 7\frac{1}{2}$ . b. *Adjidaumo minimus*, AMNH 9625, lateral view left mandible, Type,  $\times 10$ . c. *Aulolithomys bounites*, USNM 22825, lateral view right mandible,  $\times 5$ . d. *Namatomys lloydi*, CM 10046, lateral view left mandible,  $\times 10$ .





only on  $M_2$  of the type specimen in the material available. Lingually, the cingulum fuses with the base of the metaconid before reaching the lingual margin. It is also joined to the antero-internal corner of the protoconid on both  $M_1$ - $M_2$ . All the lophids on  $M_1$ - $M_2$  are low; the metalophid passes directly across the crown while the posterior lophid shows the same condition described for  $P_4$ . On both  $M_1$ - $M_2$  the mesolophid is short, reaching only to the middle of the talonid basin. The metaconids are expanded with elongate posterior buttresses which probably represent a fusion of the mesostylids with the metaconid slopes. These buttresses reach the entoconids near their bases. The posterior cingulum is short and fuses with the entoconid as in  $P_4$ .

The only third lower molar is too worn to show much of the crown pattern. As in  $M_1$ - $M_2$  the mesolophid is short, the metalophid straight, and the buccal end of the anterior cingulum was probably free at an early wear stage. The posterior half of  $M_3$  is reduced, the entoconid being set close to the metaconid, and the hypolophid shortened.

## MEASUREMENTS IN MILLIMETERS

	CM 9780	CM 10099	USNM 22825	USNM 20974
Alveolar length $P_4$ - $M_3$	—	—	7.2	6.8
Length of diastema	6.2	—	6.3	6.3
Depth below $M_1$	5.3	—	5.5	4.7
$P_4$ a-p	1.5	—	1.6	1.6
tr.	1.2-1.7	—	1.3-1.7	1.3-1.7
$M_1$ a-p	1.8	1.8	1.9	1.7
tr.	1.8-2.0	1.9-2.0	1.9-2.0	1.8-1.8
$M_2$ a-p	1.8	—	1.9	1.6
tr.	2.0-2.0	—	2.1-2.1	1.9-2.0
$M_3$ a-p	—	—	1.8	—
tr.	—	—	2.1-2.1	—
$I_1$ a-p	2.0	—	2.0	2.0
tr.	1.3	—	1.2	1.2

## RELATIONSHIPS OF NORTH AMERICAN EOMYIDS

The last review of North American eomyids was that by Wilson (1949: 112-114). At that time only three early Tertiary North American genera were known: *Protadjidaumo* from the Duchesnean late Eocene, and *Adjidaumo* and *Paradjidaumo* from the Oligocene. Since then Gal-

breath (1955) has described a fourth genus, *Centimanomys*, from the early Chadronian of northeastern Colorado, and stated that it was unlike other known eomyids in a number of dental characters but that it might be related to an undescribed form from the early Oligocene of Texas. In the same year, Wood (1955) described another new genus, *Yoderimys*, from the early Oligocene of Goshen Hole, Wyoming, and also compared it with the undescribed Texas form, erecting a new subfamily, the Yoderimyinae for *Yoderimys* and the Texas species. In the present paper, two new genera of eomyids, *Namatomys* and *Aulolithomys*, have been described as well as a second species of *Yoderimys*, thus bringing the total number of eomyid genera now recognized from the late Eocene and early Oligocene to seven.

Of these seven genera, three, *Protadjidaumo*, *Adjidaumo*, and *Paradjidaumo*, are obviously closely related as has been shown by Burke (1934). *Adjidaumo* was probably descended from *Protadjidaumo* although not from *Protadjidaumo typus*. The cheek teeth of the Duchesnean species are higher crowned and the lophids are stronger than in *Adjidaumo*, thus making *P. typus* too advanced to be directly ancestral to *Adjidaumo*. The cheek teeth of *Paradjidaumo* are much higher crowned and the loph and lophids are more prominent than in either *Adjidaumo* or *Protadjidaumo*, but the patterns are essentially similar, and it is probable that *Paradjidaumo* and *Protadjidaumo* had a common ancestor in the Uintan. It is also probable that these genera are closely related to *Eomys* of the late Eocene of Europe.

The relationships of the other five early Oligocene genera to *Protadjidaumo*, *Adjidaumo*, and *Paradjidaumo*, and to each other, are uncertain. The presence of  $P^3$  in *Yoderimys bumpi* from eastern Wyoming, is unique among all eomyids for which the upper dentition is known; and this, together with unusual loph and lophid developments on  $P^4/_4-M^3/_3$ , removes *Yoderimys* from any close relationship with other eomyids. *Yoderimys burkei* from Pipestone Springs, while known only from the lower dentition, appears to be closely related to the Wyoming species. The large anteroconid on  $P_4$ , short mesolophid on  $P_4-M_3$ , emphasis on cusps rather than lophids, and anterior position of the hypolophid all support this relationship. Although both *Yoderimys* and *Centimanomys* have at least tentatively been compared with the undescribed Texas eomyid, they do not appear to be closely related to each other. The transverse lophids on  $P_4-M_3$  are extremely prominent in *Centimanomys* while the reverse condition is seen in *Yoderimys*. This emphasis on the lophids, together with the brachyodont condition



of the cheek teeth and the narrow trigonid of  $P_4$ , isolates *Centimanomys* as another separate eomyid line with no known ancestor or descendants.

This same isolated position within the family seems to hold true also for the new Pipestone Springs genera described above. There is possibly some indication of relationship of *Aulolithomys* to *Centimanomys* in the structure of  $P_4$ . The narrow trigonid with near fusion of protoconid and metaconid is known only in these two genera among North American eomyids. However, in *Aulolithomys* there has been little emphasis on the development of the strong transverse lophids which are so prominent in *Centimanomys*, and the jaw proportions are rather different, with the diastemal length approaching the alveolar length in *Aulolithomys* (ratio .90), while the diastema length is considerably less than the alveolar length in *Centimanomys* (ratio .71). There is some resemblance between *Aulolithomys* and the early Aquitanian European *Rhodanomys* as figured by Stehlin & Schaub (1951, fig. 505), particularly in the narrow trigonid of  $P_4$  and greatly reduced to absent mesolophid on  $P_4$ - $M_3$ . *Rhodanomys*, however, appears to be higher crowned than *Aulolithomys* and also differs from *Aulolithomys* in the great reduction of the anterior cingulum on  $M_1$ - $M_3$  and the apparent loss of the posterior cingulum.

The relationships of the second new Pipestone form, *Namatomys*, are also obscure. No other member of the Eomyidae displays two protoconid-metaconid crests on  $P_4$ - $M_3$ , features that are so prominent in *Namatomys*. In some features, such as the cuspsate rather than lophate condition, the free anterior cingulum, and unreduced  $P_4$ , *Namatomys* appears to be rather close to *Protadjidaumo* and *Adjidaumo*. However, the double metalophid condition would appear to me to be of rather fundamental importance, thus removing *Namatomys* from any close relationship to the other early Oligocene eomyids.

The number and diversity of eomyids now known from the early Oligocene would seem to indicate either a much greater late Eocene radiation in North America than has been recognized to date or a considerable immigration into western North America in the latest Eocene from some other center of radiation. Three species are known from the late Eocene or early Oligocene of British Columbia but these are all of the more typical *Adjidaumo*-*Paradjidaumo* stock and give no information as to the possible ancestry or relationships of *Namatomys*, *Aulolithomys*, *Centimanomys* or *Yoderimys*. No European eomyids, other than *Eomys*, are at present known from the late Eocene; the major Old World eomyid radiation evidently took place during the Aquitanian

and Burdigalian. Thus no late Eocene eomyids are now known which could have been ancestral to four of the species in the North American early Oligocene.

It is of some interest to note that five species of eomyids belonging to five genera are present in the Pipestone Springs fauna. Four of these species are represented by no more than four specimens, while *Paradjidaumo minor* is known from more than a hundred specimens. In the case of *Namatomys lloydi*, *Aulolithomys bounites*, and *Yoderimys burkei* this paucity probably indicates that these species were not members of the community living around the area of deposition. These species are all as large as, or larger than, *Paradjidaumo minor* and I would not expect sampling bias to play a part in their rare occurrence. The situation in regard to *Adjidaumo minimus* is not as clear. Only four individuals are known, but here small size may be responsible, at least in part, for the scarcity of this species in collections. The presence of such a large number of individuals of *Paradjidaumo minor* makes it rather certain that this species was living around the area of deposition.

As Wilson (1949: 112) has pointed out, the tooth pattern in eomyids is similar to, although not identical with, the cricetodont pattern. It is quite possible that members of the Eomyidae occupied many of the same habitats that were later filled by the cricetids. No members of the Cricetidae are at present definitely known from the early Oligocene. Eumyine cricetids are abundant in the Orellan, however, and by the Arikareean, a number of cricetid types are known. The eomyids, on the other hand, appear to have had their major North American radiation during the late Eocene and early Oligocene with only *Adjidaumo* and *Paradjidaumo* persisting through the Oligocene. On the basis of occurrence it seems possible that many of the early Oligocene eomyids such as *Yoderimys*, *Centimanomys*, *Namatomys*, and *Aulolithomys* were replaced by the more highly specialized cricetids during Chadronian times.

Eomyids are known in North America after the Oligocene but they were evidently not abundant and the relationship of at least two of the later forms are unknown. The otherwise European genus, *Pseudotheridomys*, is represented in the North American early Miocene by *Pseudotheridomys hesperus* (Wilson, 1960) from the Martin Canyon Quarry A fauna. This species is closely related to European forms and evidently represents an early Miocene immigration into the New World. Two other forms are known from the Pliocene, both from single jaws. *Kansasimys dubius* (Wood, 1936) from the Hemphillian of Kansas, and

*Leptodontomys oregonensis* (Shotwell, 1956) from the Hemphillian of Oregon, are both tentatively referred to the Eomyidae. Their ancestry, however, is unknown.

Our knowledge of the family Eomyidae has increased considerably in the last decade, but an understanding of the evolution of many lines within the group will not be possible until further material is known from deposits of Uintan and Duchesnean age. The eomyids were probably descended from members of the Sciuravidae, sometime during the latter half of the Eocene, but these ancestors are not known as yet. In habitus many eomyids probably resembled cricetids and I think it is likely that they were replaced in large part by the latter.

Family HETEROMYIDAE Allen and Chapman, 1893

Genus *Heliscomys* Cope

*Heliscomys* cf. *H. vetus* Cope

Figures 5f-h

*Heliscomys vetus* Cope, 1873.

REFERRED SPECIMENS: CM 9006, fragment of left maxilla with P<sup>4</sup>-M<sup>3</sup>; CM 10101, fragment of left maxilla with P<sup>4</sup>-M<sup>1</sup>. CNHM UM 1643, LP<sup>4</sup>. CM 9230, partial left mandible with P<sub>4</sub>-M<sub>1</sub>; and CNHM PM 8627, partial left mandible with P<sub>4</sub>-M<sub>1</sub>.

DESCRIPTION: The sample is much too small to show the probable range of variation present in this population, but it is interesting to note that some of the premolar variations discussed by Galbreath (1953: 63-64) for Orellan populations are seen also in the Pipestone material.

The upper premolars show a pattern of a large, anteriorly placed protocone and a three-cusped metaloph. The protocone, metacone, and hypocone are nearly of equal size and are high and sharp. There is little tendency in P<sup>4</sup> or in M<sup>1</sup>-M<sup>3</sup> towards the formation of transverse loph. The cusps are discrete and only at a very late wear stage would they lose their individual identity. The entostyle is a small, low cusp on P<sup>4</sup> in all specimens. In CM 9006 and 10101 there is no trace of a posterior cingulum connecting the bases of the hypocone and metacone; in CNHM UM 1643, the cingulum is present. At the antero-buccal base of the protocone there is a small cusp which is found in all specimens. The size of the cusp varies, however, being much larger in CM 9006 than in the other two specimens.

The first upper molar is the largest of the four cheek teeth. The proto-  
loph is essentially two-cusped with the lingual extension of the anterior



cingulum forming a narrow ridge internal to the protocone and with no indication of a distinct protostyle. The central valley between protoloph and metaloph is deeper than the anteroposterior valleys and is open lingually. The metaloph is composed of three subequal cusps with the entostyle only slightly smaller than the hypocone and metacone. The valley between the entostyle and hypocone is not as deep as that between the hypocone-metacone and protocone-paracone. There is a short posterior cingulum which arises from near the base of the hypocone and passes to the buccal margin of the tooth.

The second upper molar agrees in most respects with the pattern seen on  $M^1$ ; the differences lie in the construction of the lingual cingulum and the styles. On  $M^2$  there is a high ridge which closes the central valley at the lingual margin. It is impossible to distinguish either a protostyle or entostyle in this ridge, but the connection to the anterior cingulum is stronger and at a higher level than is the connection to the hypocone.

The third upper molar is reduced and is composed of only two distinct cusps, the protocone and paracone, and a high internal ridge which is connected to the anterior and posterior cingulum. The metalophid is reduced and fused with the posterior cingulum and there is no trace of either the hypocone or metacone.

The mandible is rather slender but the anterior end of the masseteric fossa, at the junction of the dorsal and ventral masseteric ridges, is swollen and makes the jaw appear massive at this point. The masseteric fossa terminates under  $P_4$ , but the ventral masseteric ridge is carried forward as a heavy shelf to a point just behind the mental foramen. The ventral ridge is extremely robust, while the dorsal ridge is strong but less elevated. The latter meets the ventral ridge under the anterior end of  $P_4$ . The mental foramen is situated just below the dorsal border of the anterior end of the mandible and closer to  $P_4$  than the incisor. The diastema is short and the diastemal depression shallow.

The incisor is slender with a rounded anterior face. The enamel overlaps onto about one-fifth of the medial surface and one-third of the lateral surface.

In CM 9230,  $P_4$  is quadricuspedate, while in CNHM PM 8627 the premolar has only three cusps. In the latter specimen the metaconid, hypoconid, and entoconid are of equal size and height with a narrow, deep valley separating the metaconid and entoconid and a broader and equally deep valley separating the hypoconid and entoconid. The antero-external quarter of this tooth consists of a flat shelf with no indi-

cation of even a minute protoconid in this area. Between the hypoconid and entoconid at the posterior margin of the tooth there is a faint indication of a hypoconulid. In CM 9230 the three high spike-like cusps are present and there is also a well developed protoconid which rises almost to the same level as the metaconid. These two cusps are set close together, much more so than are the hypoconid and entoconid, but are separated by a deep valley. In this specimen the hypoconulid is somewhat larger than in CNHM PM 8627.

The first lower molars are identical in the two specimens. There are two transverse rows of three cusps each, completely separated by a deep central valley. As in the upper molars the teeth are cuspsate rather than lophate. The protostylid and hypostylid are almost the same size as the four principal cusps. The anterior cingulum is elevated into a rather high, thin ridge and there is a deep valley between it and the protoconid and metaconid; it is fused with the protostylid about mid-way down the anterior face of that cusp. A posterior cingulum is present but it is narrow and low.

## MEASUREMENTS IN MILLIMETERS

		CM 9006	CM 10101
Alveolar length	P <sup>4</sup> -M <sup>3</sup>	3.4	3.3
P <sup>4</sup>	a-p	.9	.7
	tr.	.5- .8	.4- .8
M <sup>1</sup>	a-p	.9	.9
	tr.	1.0- .9	1.0-1.0
M <sup>2</sup>	a-p	.8	—
	tr.	.9- .9	—
M <sup>3</sup>	a-p	.6	—
	tr.	.7	—

## MEASUREMENTS IN MILLIMETERS

		CM 9230	CNHM PM 8627
Alveolar length	P <sub>4</sub> -M <sub>3</sub>	—	3.4
Length of diastema		2.4	—
Depth below M <sub>1</sub>		2.7	2.7
P <sub>4</sub>	a-p	.6	.6
	tr.	.4- .6	.4- .6
M <sub>1</sub>	a-p	.9	.8
	tr.	.9	.8
I <sub>1</sub>	a-p	1.1	—
	tr.	.4	—

**AFFINITIES:** In size these specimens appear to be slightly larger than the mean for the Orellan populations from northeastern Colorado discussed by Galbreath (1953: 65). However, a larger sample from Pipestone would certainly give a greater size range than is at present exhibited, and the difference is so small between the two Colorado populations and that from Pipestone that it does not in itself warrant specific recognition of the Montana material. Also, the structure of the cheek teeth and the variation seen in this sample coincide well with that observed in the later Colorado populations.

It is somewhat surprising that the morphological variation observed in the middle Oligocene populations is duplicated in the early Oligocene Pipestone material. Wood (1939: 560), Wilson (1949: 115), and Galbreath (1953: 65) have all suggested that the four-cusped condition of  $P_4$  was primitive and that the three-cusped condition represented reduction from that more primitive stage. This would certainly seem the most probable evolutionary pattern in *Heliscomys*. However, if this were the case, it would appear that the reduction and eventual loss of the protoconid on  $P_4$  was not under strong selective pressure since both the three-cusped and four-cusped condition persisted at least from the early Oligocene through the middle Oligocene and possibly even somewhat later. This variation suggests that *Heliscomys* was ancestral to *Proheteromys*. Fragmentation and isolation of portions of an *Heliscomys vetus* population such as is represented at Pipestone Springs or in northeastern Colorado could have resulted in the evolution of one line which lost the premolar protoconid entirely and another which emphasized the enlargement of  $P_4$ , retention of the protoconid, and eventual addition of a fifth cusp, the anteroconid. The first line could have led to *H. woodi*, known from the early Miocene, and the second line to *Proheteromys*.

Recently Reeder (1960) has described two genera of heteromyids from the middle Oligocene. One, *Apletotomeus*, has a four-cusped  $P_4$  with a slight swelling anterior to the metaconid; the other, *Akmaiomys*, has a rather large anteroconid which is antero-posteriorly elongated. *Apletotomeus crassus* could easily be derived from *Heliscomys vetus* and it is quite probable that the two species are congeneric. The large size of the incisor would appear to separate these populations as distinct species but this character alone does not warrant a generic distinction between the two. *Akmaiomys incohatus* resembles *Proheteromys floridanus* in the pattern of  $P_4$  and certainly seems referable to that genus. The antero-posterior elongation of the anteroconid on  $P_4$  is vari-

able in *P. floridanus* (Black, 1963a), some specimens showing a greater elongation of the anteroconid than is seen in *Akmaiomys crassus*; while in other specimens the anteroconid is minute to absent. Galbreath (1953: 66) originally referred the type of *Akmaiomys crassus* to *Proheteromys*? sp. This assignment seems likely, especially in view of the variation now known for  $P_4$  of *Proheteromys floridanus*.

The variation seen in  $P_4$  of both *Heliscomys* and *Proheteromys* has led to considerable confusion as regards the proper specific and generic determination of Oligocene and early Miocene specimens of heteromyids. It is quite possible that species assigned to *Heliscomys*, *Proheteromys*, *Mookomys*, *Apletotomeus*, and *Akmaiomys* are all congeneric and that we are dealing with a highly variable set of populations none of which have yet reached the perognathine-heteromyine level of development; this was first suggested by Wilson (1960: 75). Only a thorough review of the Oligocene *Heliscomys* populations can hope to solve these problems.

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A SMALL COLLECTION OF BIRDS FROM THE ISLAND OF  
BUAD, PHILIPPINES

KENNETH C. PARKES

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In his chapter on the history of ornithology in the Philippine Islands, Hachisuka (1931: 48) made the following statement:

"The Fleming collection in Toronto has some six hundred and twenty-five skins from the Philippines. These were collected between 18th April 1909 and 21st November 1910, by J. J. Mounsey, an engineer. It appears that the places visited by him were Mindoro, Luzon, Samar, Leyte, Cebu and Mindanao. The skins were not well prepared, but they carry full scientific data on labels."

In discussing the history of bird collecting on the island of Leyte, Rabor (1938: 15) referred to the same collection, supposed to contain birds from Leyte, and mentioned that no list of these had been published. Neither Hachisuka nor Rabor examined any of the specimens from this collection.

As I have been engaged in compiling a complete list of the birds of Leyte, it was necessary for me to learn more about these specimens, and to see them if possible. The Fleming collection is now in the Royal Ontario Museum in Toronto, and Mr. L. L. Snyder of that institution was good enough to send me a list, taken from the catalogue, of the specimens alleged to be from Leyte. The locality on the collector's original labels is given merely as "Zamarraga" or "Zumarraga," to which, on the Fleming collection labels, is added "—Buad de Leyte." I can find no locality on the island of Leyte, in any available map or gazeteer, named "Zamarraga," "Zumarraga," or "Buad." However, there is an *island* named Buad, of which the principal town is Zumarraga, and I have no doubt that this locality is the actual source of the Mounsey specimens. Mr. Snyder was kind enough not only to send me these specimens on loan, but to permit me to publish this list of the collection, as it appears that there are no other records from Buad in the literature of Philippine birds.

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I have been unable to determine the significance of the usage "Buad de Leyte" on the labels of the Mounsey birds, as Buad is geographically a part of Samar rather than of Leyte. According to the "Pronouncing Gazetteer and Geographical Dictionary of the Philippine Islands" (Bur. Insular Affairs, U. S. War Dept., 1902: 380), the island of Buad is seven by four miles in size, with a central peak rising to 1,155 feet. It lies at the entrance to Maqueda Bay, about six miles south of the town of Catbalogan, midway along the west coast of Samar. The birds collected by Mounsey in 1910 suggest that the habitat was lowland-foothill forest.

Rand and Rabor (1960: 364) stated that only two collections of birds were made on Samar between 1900 and 1957, one in 1924 for the Philippine Bureau of Science and one in 1952 for its successor, the Philippine National Museum. Hachisuka, however, as quoted above, listed Samar among the islands visited by Mounsey, and this could not refer to the Buad collection, as the latter was thought to have come from Leyte. In any case, Buad is geographically and faunally part of Samar, and Buad records may be considered, for all intents and purposes, Samar records. Details of earlier Samar expeditions may be found in Rand and Rabor (1960) as well as in Hachisuka (1931). Reference may be made below to Steere, to Bourns and Worcester, and to Whitehead; these refer to the three major Nineteenth Century Samar collections as listed by Rand and Rabor (1960).

As mentioned above, I am indebted to Mr. L. L. Snyder of the Royal Ontario Museum for permission to report on this collection. Most of the study was carried on at the American Museum of Natural History, New York, in connection with my work on Leyte birds, supported by a grant from the Frank M. Chapman Memorial Fund. Carnegie Museum specimens were used as comparative material, as were certain specimens from the Chicago Natural History Museum and the Peabody Museum of Natural History, Yale University, through the courtesy of Austin L. Rand and S. Dillon Ripley, respectively.

The Buad collection consists of 38 specimens, of which I have examined all but three (these are noted in the text, below). They were collected by Mounsey between June 15 and 23, 1910, and were purchased by J. H. Fleming from the dealer W. F. H. Rosenberg in London in 1912. For each specimen, the Fleming collection number, Mounsey's original number in parentheses, date, and sex are given. For some species there are remarks on taxonomy, distribution, and molt; terminology of molts and plumages is that of Humphrey and Parkes (1959). An explanation is given for any scientific names used which differ from

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those used in the well known handbook by Delacour and Mayr (1946).

*Butorides striatus carcinophilus* Oberholser. Little Mangrove Heron. 24418 (425) ♂ June 19; 24419 (426) ♀ June 19; 24420 (446) ♂ June 22.

These specimens belong to the small resident race, which, according to Rand and Rabor (1960: 373) has been collected on Samar only by Steere and by Bourns and Worcester. In the Samar material studied by Rand and Rabor only the large migrant race, *B. s. amurensis*, was represented.

*Ptilinopus leclancheri leclancheri* (Bonaparte). Black-chinned Fruit Dove. 22216 (438) ♀ June 21.

This species appears to be quite uniform in the Philippines; in fact, specimens in the American Museum of Natural History do not uphold the supposed Palawan race *P. l. gironieri*.

*Ducula aenea aenea* (Linnaeus). Green Imperial Pigeon. 22228 (436) ♂ June 21.

Stresemann (1952: 520) has shown that the type locality of *Columba aenea* Linnaeus should properly be Manila, so the name *chalybura* Bonaparte, used by Delacour and Mayr (1946) and others for the Luzon race, becomes a synonym of *aenea*. The population formerly known as *D. a. aenea* takes the name *D. a. polia* (Oberholser).

The name *D. a. glaucocauda* Manuel has had a rather checkered career. It was originally proposed (Manuel, 1936: 410-412) for the birds of Samar, Biliran, and Mindanao, on the basis of their having the upper surface of rectrices, primaries and secondaries "appearing as if covered with a fine gray powder." Mayr (1944: 147) attributed this variation in wing and tail color to "wear and staining with grease." Delacour (*in* Delacour and Mayr, 1945: 107) rejected *glaucocauda*, stating that the character used by Manuel was unreliable as it depended entirely upon the freshness of the skin. Delacour's statement (erroneously attributed to Mayr) was disputed by Salomonsen (1952: 344), who revived the name *glaucocauda* on the basis of his examination of recently-collected material in the Philippine National Museum consisting of 6 Samar and 2 Mindanao specimens, compared with 3 from Polillo, 2 from Mindoro, and 4 from Negros. In addition to the "bloom" on the

flight feathers described by Manuel, Salomonsen characterized "*glauco-cauda*" as smaller than the other Philippine races; his wing measurements for "*glauco-cauda*" were 227-245 mm. versus 228-256 mm. for "*chalybura*" [= *aenea*].

Salomonsen's findings, in turn, were not accepted by de Schauensee (1957: 5-6), who compared 3 specimens from Sorsogon, southern Luzon, with 8 from Mindanao. He could find no difference in color of wings and tail between the two series, and stated that measurements of his specimens showed "just the opposite to that which was found by both Manuel and Salomonsen." Manuel, however, had not invoked size as a character of "*glauco-cauda*," and the figures given by de Schauensee as "Manuel's measurements for Mindanao birds" are actually those of Salomonsen's *total* series (Mindanao + Samar). Manuel gave only the measurements of his type specimen (wing 234 mm.), although he did give tables of measurements for the races "*chalybura*," *fugaensis*, and *palawanensis*. His figures for "*chalybura*" (wing 232-250 mm.) plus the measurements given by de Schauensee (Luzon, 222-235 mm.; Mindanao, 233-252 mm.), Rand and Rabor (1960: 329, 381) for Bohol (234-245 mm.) and Samar (220-241 mm.), and Ripley and Rabor (1958: 31) for Mindoro (233-249 mm.) all indicate that there is no important difference in size among the populations of these islands. Ripley and Rabor, although not specifically mentioning "*glauco-cauda*," rejected it by implication in stating that their Mindoro specimens were "similar to specimens from Mindanao and Negros."

Finally, Rand and Rabor (1960: 381) revive "*glauco-cauda*," pointing out that Samar and Bohol specimens show the greatest development of the bloom on the flight feathers. Of the four Mindanao specimens they mention, they considered two to "approach *D. a. aenea*."

The excellent series of this species now in the American Museum of Natural History, substantially larger than that available to any previous author, shows that the geographic separation is not so clearly defined as suggested by Rand and Rabor. The bloom on flight feathers is rather consistently present in specimens from Samar and Leyte, less so in specimens from Mindanao, as they state. A number of specimens from southern Luzon, however, also show this character, probably accounting for de Schauensee's failure to find a difference between Sorsogon and Mindanao specimens in this respect. The bloom itself is of external origin, or develops only with full growth of the feather. This is amply demonstrated by such specimens as AMNH 610984 (Davao, Mindanao, June 20, 1889), 610985 (Davao, April 30, 1889), and 768199 (Balin-



sasayao, Leyte, July 8, 1961), all of which have partly grown incoming primary feathers which conspicuously *lack* the bloom. Although there may be geographic variation in some genetic factor controlling, for example, friability of feather barbules, I doubt that such a character should be used to distinguish a taxonomic unit until a genetic basis can be established. The American Museum series of the non-Philippine races, notably the populations of the Lesser Sunda Islands, shows that there is inconsistency in the presence or absence of this bloom in some populations, and that it is also absent on incoming feathers in these populations. The name *glauco-cauda* Manuel is therefore here considered a synonym of *aenea*.

*Chalcophaps indica indica* (Linnaeus). Green-winged Ground Dove.  
22249 (407) ♂ June 16; 22250 (no Mounsey number) ♀ June 18.

The Philippine population of this widely distributed species is generally listed under the nominate race, for which the correct type locality, according to Stresemann (1952: 511), is Amboina Island in the Moluccas. Peters (1937: 114) credited this race with an extensive range from peninsular India to the western Papuan islands, but admitted in a footnote that this treatment was tentative because of insufficient material. Ripley (1961: 167) used the name *indica* for the population of India and East Pakistan, and Ripley and Rabor (1958: 33-34) used the name for Philippine birds, although they pointed out that there is much variation, apparently correlated with geography, in the color of females (much less so of males) within the range currently assigned to *C. i. indica*. Hachisuka (1939: 46-47) used the name *Columba pileata* Scopoli (type locality Panay) for the Philippine population, but he considered the mainland birds to be typical *indica*, and specifically stated that he had made no comparisons with birds from (among other places) Amboina. I have, in fact, seen no comparisons made, in print, between Amboina specimens and those from the Philippines on the one hand and from India on the other. As mentioned above, geographic variation in this species is best expressed in females. I have seen only males from Amboina, and cannot separate these from Philippine specimens. The latter are therefore provisionally identified as *C. i. indica* (Linnaeus), and another name will probably have to be found for the Indian birds.

*Cacatua haematuropygia* (Müller). Philippine Cockatoo. 22383 (419)  
♀ June 17; 22387 (420) ♀ June 17.



The large series of this species in the American Museum of Natural History confirms the conclusion of Rand and Rabor (1960: 420) that no separation of subspecies on the basis of size is possible. Even some of the slight geographic variation in measurements noted by these authors appears to have been a function of the small size of their samples. This relative uniformity throughout the Philippines contrasts sharply with the polytypy of the other Philippine parrots, suggesting the possibility that *Cacatua* may be a relatively recent and highly successful colonizer of the archipelago.

Both of the Buad specimens are very worn and dirty, with the complete (presumably prebasic) molt well under way.

*Loriculus philippensis worcesteri* Steere. Philippine Hanging Parakeet.  
22407 (442) ♀ June 22.

The specimen is an adult female, with *all* of its rectrices and upper tail coverts, as well as a few adjacent rump feathers, just beginning to emerge from their sheaths. No molt is apparent on the wings nor elsewhere on the body. Of the 49 specimens of this species in the Carnegie Museum collection, only three illustrate tail molt, and of these, two are also molting in other tracts. The third specimen, a male of the subspecies *L. p. panayensis*, is just completing its first prebasic molt, with some sheathed rectrices the *last* feathers to appear. There is nothing in any of these specimens to suggest a drastic molt in the caudal region, and the Buad bird was almost certainly replacing accidentally lost feathers.

*Ninox philippensis philippensis* Bonaparte. Philippine Boobook Owl.  
22174 (409) ♀ June 16.

This species is credited to the island of Samar by Delacour and Mayr (1946: 118), but is not listed among the birds of Samar by Rand and Rabor (1960). McGregor (1909) does not record it as having been collected on Samar. The only Samar record of this owl I have been able to find in the literature is a mention by Ogilvie-Grant (1897: 210) that *Ninox philippensis* was among the species in Whitehead's first collection from Samar, which was totally destroyed in a fire aboard ship (see Ogilvie-Grant, 1896: 458). The Buad bird thus appears to be the only extant Samar specimen of *Ninox philippensis*. It is, unfortunately, a very poor skin; as far as can be determined, it does not differ from specimens of the nominate race from Luzon (to which the type locality of *philippensis* was restricted by Mayr, in Delacour and Mayr, 1945: 108).

*Pelargopsis capensis smithi* (Mearns). Stork-billed Kingfisher. 22432 (412) ♂ June 17; 22433 (413) ♀ June 17; 22434 (424) ♀ June 19.

I have not seen topotypical specimens from Masbate of this race, but have compared the Buad birds with a series of 3 from Negros, 3 from Polillo, 1 from Leyte, and 2 from Mindanao, and noted no geographic variation. According to Rand and Rabor (1960: 390) this species has not been collected on Samar since Whitehead.

*Halcyon smyrnensis gularis* (Kuhl). White-throated Kingfisher. 22449 (430) ♀ June 20.

This specimen is exceptionally worn, and had not begun to molt.

*Halcyon chloris collaris* (Scopoli). White-collared Kingfisher. 22453 (439) ♀ June 21.

This specimen was not examined. According to Rand and Rabor (1960: 391) this common species has been collected on Samar only by Steere and by Bourns and Worcester.

*Eurystomus orientalis cyanicollis* Vieillot. Dollar Bird. 22489 (450) ♀ June 23.

This specimen was not examined. For the use of the subspecific name *cyanicollis* (not "*cyanocollis*" as spelled by Rand and Rabor, 1960) rather than *orientalis*, see Stresemann (1952: 519).

*Buceros hydrocorax semigaleatus* Tweeddale. Calao. 22273 (429) ♀ June 19.

This specimen was not examined.

*Artamus leucorhynchus leucorhynchus* Linnaeus. White-breasted Wood-Swallow. 22636 (427) ♀ June 19.

The specimen is a full-grown juvenile, beginning its first prebasic molt on the underparts. This widely distributed subspecies shows no geographic variation from northern Luzon through Borneo.

*Pycnonotus goiavier samarensis* Rand and Rabor. Yellow-vented Bulbul. 22601 (416) ♀ June 17; 22602 (443) ♀ June 22.

This recently described subspecies (Rand and Rabor, 1960: 346) is a valid one, but some of the characters claimed for it do not hold. The color of the crown and ear coverts, supposedly darker and more blackish than in nominate *goiavier*, does not differ from the latter when specimens of equal wear and museum age are compared. Freshly molted birds have substantially darker crowns than even slightly worn ones from the same geographic area. The heavier breast streaking and darker flanks of *samarensis*, on the other hand, are immediately apparent when compared with *goiavier* of equal age. This evaluation of the characters of *samarensis* is exactly the opposite of that of de Schauensee and du Pont (1962: 163), who emphasized crown color of Leyte birds (not seen by Rand and Rabor, but assigned by those authors to *samarensis* on the basis of probability) as compared to Luzon birds. They found "the heavier streaking on the breast . . . not apparent." However, I have examined the specimens at the Academy of Natural Sciences of Philadelphia upon which these conclusions were based, and found that the Luzon material was old, faded and discolored. My own comparisons were made using the abundant, recently collected material at Carnegie Museum and the American Museum of Natural History.

The smaller size of *samarensis* is also upheld by specimens I have measured, although the overlap is slightly more than indicated by the series measured by Rand and Rabor (1960: 347). They had only 5 males (wing 86-89 mm.) and 4 females (wing 80.5-87 mm.) from Luzon to compare with their good series of 14 Samar males (wing 77-83.5 mm.) and 10 females (wing 74-78 mm.). Carnegie Museum has 21 measurable topotypical specimens of nominate *goiavier* from the general vicinity of Manila. Of these, 13 males measure wing 83-88 mm., and 8 females wing 77-86 mm. Although a longer series of both races might show a few millimeters more overlap, there is clearly a significant size difference.

The two Buad specimens are both just beginning their first prebasic body molt on the back and breast, the molt being slightly more advanced on the June 22 specimen than on that from June 17. Their wing measurements (73, 75.5) are typical of *samarensis*.

*Hypsipetes philippinus saturator* (Hartert). Philippine Bulbul. 22583 (405) ♂ June 15; 22584 (411a) sex? June 16; 22585 (411) ♂ June 16; 22586 (414) ♂ June 17.

This is the species formerly known as *Microscelis gularis*; for the change in name, see Rand and Rabor, 1959.

Examination of a large amount of excellent material of this species shows that current concepts of its races need to be somewhat revised. De Schauensee and du Pont (1962: 163-164) have recently shown that *H. ruficularis* on Mindanao is not confined to Zamboanga as stated by Rand and Rabor (1960: 429), but extends at least as far east as Lake Lanao, where it overlaps both *H. philippinus* and *H. everetti* (with each of which it has by some authors been considered conspecific; see Rand and Rabor, 1959: 103), and must thus be considered a separate species. Deignan (1960: 286-287) admitted the subspecies *H. p. saturator* (Hartert), limiting its range to "eastern Mindanao," but as mentioned above, de Schauensee and du Pont have shown that it extends west to Lake Lanao. Rand and Rabor (1960: 428) considered *saturator* a synonym of *philippinus* without specifying the extent of their Luzon (topotypical) material of the latter, while de Schauensee and du Pont (1962: 163), with only two Luzon specimens available, also synonymized *saturator* with *philippinus*.

The chief difficulty in recognizing *saturator* seems to be the concept of it as an endemic race of Mindanao. De Schauensee and du Pont, for instance, appear to have compared Mindanao birds on the one hand with Luzon, Samar and Leyte birds on the other. It is understandable that, using this procedure, they would not consider *saturator* separable. In point of fact, however, the area of greatest differentiation from Luzon birds is not eastern Mindanao but Samar and Leyte. Specimens from these islands average darker overall than those from Luzon, but the best character is the color of the underparts. The Samar/Leyte birds have darker and more extensive pigmentation on the flanks, reducing to a mere trace in some specimens what is a fairly extensive white mid-ventral area in *philippinus*. The streaking of the underparts is also heavier than in Luzon birds. Specimens from eastern Mindanao (topotypes of *saturator*) are closer to Samar/Leyte birds than to Luzon birds in color, so the latter name may be used for this dark population. Cebu specimens are also closest to *saturator*; I have not examined Bohol specimens, which should belong here also. There is some overlap of *saturator* and *philippinus* through individual variation, but enough specimens are readily assignable to one or the other to make it practical, in my opinion, to recognize both races.

It is obvious that Delacour and Mayr (1946: 175) should have compared *saturator* with "*gularis*" (= *philippinus*) rather than with "*guimarensis*" (= *guimarasensis*). Their comparison of the latter two races is also misleading, as *guimarasensis* is not "paler on the throat," but



darker and less brightly rufescent than *philippinus*. They state that *guimarasensis* is "very slightly larger," but the wing measurements of the two races given by Rand and Rabor (1960: 428) show no overlap, and the bill of *guimarasensis* is also conspicuously larger than that of *philippinus*.

The four June specimens from Buad are all badly worn and frayed, and had not yet begun to molt; adults of this subspecies from Leyte in the American Museum of Natural History had not yet begun the pre-basic molt as late as July 10. Adults of *philippinus* from central Luzon in Carnegie Museum were just beginning this molt on dates ranging from July 12 to August 8.

*Copsychus saularis mindanensis* (Boddaert). Dyal. 24341 (no Mounsey number) ♂ June 22.

According to Rand and Rabor (1960: 399), this species has been collected on Samar only by the Steere expedition.

*Macronus striaticeps mindanensis* Steere. Brown Tit-Babbler. 22612 (428) ♀ June 19; 22613 (440) ♀ June 21.

This species has recently been reviewed by Rand and Rabor (1960: 429-430), utilizing the material in the Chicago Natural History Museum. Their revision left certain questions open, particularly the status of the two Mindanao races, *mearnsi* and *mindanensis*, and the relationship of Mindanao lowland and Samar birds. They did not examine specimens from Leyte. As it was necessary for me to determine the correct name to use for the Leyte population, I assembled an excellent series composed of the pertinent specimens from the American Museum of Natural History, Peabody Museum of Natural History, and Chicago Natural History Museum. The races *striaticeps* of Basilan and *kettlewelli* of the Sulu Archipelago, the most sharply defined of the subspecies, were examined briefly but did not form a part of this study.

Rand and Rabor (1960: 430) give the range of *M. s. mindanensis* Steere (type locality Ayala, Mindanao) as "western and southern Zamboanga," but comment in their discussion of *M. s. mearnsi* Deignan that "there is a possibility that *mearnsi* is a mountain form only, and that the lowlands are inhabited by a form very close to *cumingi* or *mindanensis*." In addition to one of the two Cotabato specimens described by Rand and Rabor as being close to Samar birds in color, I have examined two specimens from Davao and three from Mailag,



Bukidnon, all from relatively low elevations on Mindanao. These all differ from *mearnsi* in reduced ventral streaking and less ruddy dorsum, and cannot satisfactorily be separated from an excellent series of *mindanensis* from Zamboanga. This confirms the suggestion of Rand and Rabor that *mearnsi* is a highland and *mindanensis* a lowland race in Mindanao. I have examined specimens of *mindanensis* from Matam, Katipunan, Zamboanga, a lowland locality less than 30 miles from the summit of Mount Malindang, a highland area inhabited by *mearnsi*.

For the population of Samar (and, tentatively, Leyte and Dinagat), Rand and Rabor revive the name *cumingi* Hachisuka (misspelled "*cummingi*" by several recent authors). This name was based on a single specimen from the Cuming collection in the British Museum, thought by Hachisuka to have come from Manila. As Rand and Rabor show, however, this locality is erroneous beyond any reasonable doubt; the type specimen matches Samar birds, and they hence substitute Samar for Manila as type locality (for a parallel case involving a Cuming specimen, see Parkes, 1961: 3-4).

I have compared an excellent series of 26 specimens of "*cumingi*" from Samar and Leyte with 12 Mindanao specimens of *mindanensis*, and cannot find a single color difference that is not completely bridged by individual variation in a substantial number of specimens. Rand and Rabor themselves have called attention to the similarity of specimens from Cotabato, Mindanao, to those of Samar. I therefore consider *cumingi* Hachisuka, 1934, a synonym of *mindanensis* Steere, 1890, and refer to the latter the populations of Samar, Leyte, and lowland Mindanao, both eastern and western. Incidentally, de Schauensee and du Pont (1962: 164) are in error in claiming that theirs is the first record of this species from Leyte, as it was collected there by several previous expeditions, including those of Steere and of Whitehead (McGregor, 1909: 535).

Within the Mindanao highland race *mearnsi* there are, as suggested by Rand and Rabor, some tendencies toward geographic variation, as would be expected in view of the insular type of distribution of such a highland form. Topotypes from Mount Apo are the most rufous below, with streaks rather blurred as well as washed with rufous. A series from Mount Katanglad shows heavier, more distinctly contrasting ventral streaking, as well as a darker, less rufescent color. Specimens from Mount Malindang, Zamboanga, although from an area geographically well removed from the other two mountain masses mentioned, are actually somewhat intermediate, as a series, between Apo and Katan-

glad birds. They are more distinctly streaked than Apo specimens, less so than those from Katanglad, and are whiter, less washed with rufous below than are Apo birds. Rand and Rabor mention three specimens from Mount McKinley as exhibiting individual variation. Of these three, which I have examined, one is the coldest (least rufescent), most distinctly streaked specimen of *mearnsi* that I have seen. The other two match closely, surprisingly, not birds from nearby Mount Apo, but a long series from Mount Katanglad. In spite of these obvious tendencies, it does not appear worthwhile to attempt to recognize nomenclatorially more than one highland Mindanao subspecies.

The subspecies *boholensis* Hachisuka, recognized by Rand and Rabor, is not very well differentiated from *mindanensis*. In series, the difference in color of upperparts between *boholensis* and "*cumingi*" described by these authors does not hold good. The subspecies can be maintained, however, on the basis of average whiter, more distinct ventral streaking, paler flanks, and paler under tail coverts.

The two Buad specimens are both worn adult females, just beginning their body molt on the underparts but not yet molting flight feathers.

*Rhipidura javanica nigritorquis* Vigors. Malaysian Fantail. 24376 (421) ♂ June 17.

Some minor tendencies toward geographically correlated variation can be noted in this species within the Philippines. In color, this is manifested chiefly in the extent of white on the tips of the rectrices, with Palawan birds exhibiting the most white and Negros birds the least. The partially black throat which appears as a color phase or mutation in other subspecies, especially *longicauda*, is apparently absent in the Philippine population. As for size, in general Palawan, Samar and Leyte birds average largest, followed by those from Mindanao and Basilan, while Luzon, Marinduque and Sulu birds are the smallest. There is no clear basis in any of this variation for a subdivision of *nigritorquis*, although relatively few specimens, less than 40 from the entire Philippine archipelago, were examined.

The Buad specimen is very worn, and had apparently not yet begun to molt; it is poorly made, and could not be examined thoroughly. According to Rand and Rabor (1960: 403), this species has been collected on Samar only by Bourns and Worcester.

*Cyornis rufigastra philippinensis* Sharpe. Mangrove Blue Flycatcher. 24383 (423) "♀" [= ♂] June 18.

Rather than follow Delacour and Mayr (1945: 113) and others in using an exceedingly broad genus *Muscicapa*, I subscribe to the opinion expressed by Rand and Fleming (1957: 173-174) and by van Bemmel (1948: 345, footnote), and follow Vaurie (1953) in subdividing this group. Vaurie used the generic name *Niltava* for this and related species of blue flycatcher (in which he was followed by Rand and Rabor, 1960), but he has told me that after having seen true *Niltava* in life, he changed his opinion and would recognize the *Cyornis* group as a separate valid genus (letter of October 23, 1957).

Within the range now ascribed to the subspecies *philippinensis*, there is a slight amount of geographic variation. A small series from the Sulu Archipelago is somewhat more intensely colored on the breast than other *philippinensis* seen. In dorsal coloration, Negros birds are slightly brighter blue, Mindanao and Basilan birds the dullest. One female from Siquijor in the American Museum of Natural History has a much greater extent of rufous on the underparts than any other specimen seen, with white limited to a small patch on the abdomen. However, Dr. Rand informs me (letter of May 21, 1962) that this description does not apply to the series of Siquijor specimens in the Chicago Natural History Museum.

*Hypothymis azurea azurea* (Boddaert). Black-naped Blue Monarch.  
22620 (415) ♂ June 17; 22621 (432) ♀ June 20.

Ripley (1961: 438) has combined the genera *Hypothymis* and *Monarcha*, but, as pointed out by Mayr (1962), erroneously used *Monarcha*, the junior name, for the combined genus. The present species, therefore, will retain the name as given above whether or not one subscribes to Ripley's "lumping" of these two genera.

I fully agree with Mayr (in Delacour and Mayr, 1945: 113) that the proposed race *H. a. compiler* Peters cannot be upheld. I do not see even a trend toward the supposed whiter abdomens in southern Philippine versus Luzon specimens. There is much variation among Philippine populations of this species, especially among females, and certain trends or patterns of variation can be detected. Mayr (*loc. cit.*) has already called attention to the possibility that Sulu birds may be separable. Some of the trends I noted among females are as follows: the bluest and most richly colored on head and underparts are six from the Bataan peninsula, Luzon, and one from Mindoro; the grayest, least blue, are those from Basilan, Mindanao and Samar; eight from central

and southern Luzon and one from Panay show the sharpest contrast between the blue of the throat and the gray of the breast. It appears that subdivision of *H. a. azurea* probably could not be accomplished without a highly impractical splintering.

The Buad birds, like so many others in this collection, are exceedingly worn, rather poor specimens.

*Nectarinia jugularis jugularis* (Linnaeus). Olive-backed Sunbird. 24395 (417) ♂ June 17; 24396 (418) ♀ June 17; 24397 (434) ♂ June 20.

I follow Rand (1951b) in using the name *N. j. jugularis* to cover the highly variable series of populations of this sunbird extending from southern Luzon to Mindanao and Basilan, leaving to a later paper a detailed discussion of my study of this species.

The Buad specimens are all very worn. Both of the males, especially 24395, are near the orange-breasted ("*dinagatensis*") extreme of *jugularis*. Male no. 24397 shows the brown line between the orange breast and metallic throat, described by Rand (1951b: 599) as an individual variation more common and pronounced in birds from the northern islands.

*Oriolus chinensis yamamurae* Kuroda. Black-naped Oriole. 24325 (408) ♂ June 16; 24326 (441) ♀ June 22.

Since the publication of Delacour and Mayr's book (1946), two authors have critically reviewed the Philippine races of this oriole. Gilliard (1949) recognized five races (two new) in the Philippines proper, but did not discuss Palawan birds. Rand (1951a) admitted only two subspecies of Gilliard's five, plus *palawanensis*. My own study of this species has led me to conclusions differing from those of either of the above authors. It is necessary for me to place my findings on record here to explain my choice of name for the Buad specimens.

As mentioned above, Gilliard did not discuss the validity of *palawanensis* Tweeddale. Rand recognized this race, characterizing it only by "the wide yellow band on the forehead of the male, while the female overlaps in characters with those of the north Philippine populations." Rand lists, in his table of measurements, only a single male from Palawan, with a yellow forehead band of 23 mm., as compared with seven males from the Manila region with forehead bands of 12 to 20 mm. However, a series of nine males from central Luzon in Carnegie Museum, with forehead bands ranging from 14 to 24 mm. wide, completely brack-



ets the series of adult males from Palawan in the American Museum. Rand has already admitted that females of "*palawanensis*" cannot be distinguished from Luzon females, so it is apparent that there is no justification for the recognition of a Palawan race.

On Luzon and the adjacent islands toward the south, there is, in fact, a cline from north to south in the direction of a *reduction* of width of forehead band. Gilliard's proposed subspecies "*sorsogonensis*" from southern Luzon is, as suggested by Rand, merely a point along this cline. This may also be true of *fugaensis* Gilliard, based on a single female from Fuga Island, north of Luzon; I follow Rand in tentatively synonymizing this proposed race with *chinensis* pending examination of additional material from the islands in Luzon Strait.

Rand assigned to *suluensis* Sharpe the populations of "the southern Philippines, north at least to Mindanao." His table of measurements lists only one specimen, a female from Sibutu, from the Sulu Archipelago. Parts of his characterization of *suluensis* do not accord at all with the material I have examined. I find no foundation whatsoever for the statement that *suluensis* is characterized by an "average more greenish back." As for the "more frequent occurrence of green in the tail," not a single fully adult male specimen examined shows any green in the tail, and the "subadult" birds that *do* have green in the tail have no more of it than do comparable Luzon specimens: Females (but not males, *contra* Rand) seem to attain the bright orange definitive plumage less often than do Luzon females; thus, most females have some green in the tail, but so do all Luzon birds in the "green-backed" plumages. Rand states that the female of *suluensis* lacks the yellow tips to the secondaries; actually, these vary individually from present but minute to absent, regardless of sex.

Gilliard admitted *yamamurae* Kuroda for specimens from Mindanao and Basilan, separating it from *suluensis* entirely on the basis of a much shorter tail (♂♂ 100-106 mm. versus 111-118 mm. for *suluensis*). Rand acknowledges this (*op. cit.*: 592), but then (p. 593) proceeds to synonymize *yamamurae* with *suluensis* because Gilliard's wing measurements for *suluensis* were small (148-156.5 mm. versus 153-156.5 for Mindanao/Basilan males), whereas Meinertzhagen (1923) had given measurements indicating that Sulu males had long wings (152, 161-170 mm.). Rand made no further mention of tail length, the only character Gilliard had claimed distinguished *yamamurae* and *suluensis*.

I have examined the same Sulu birds used by Gilliard, and find that the small wing measurements given in his table for these specimens are



highly misleading. In the first place, Gilliard was the victim of a most unfortunate typographical error; his largest Sulu male measures wing 165.5 mm., not 156.5 mm. as printed. The smallest specimen (wing "148" mm.) has the longest primaries broken off on both sides, and should not have been used in the measurements. The third male measures wing 154 mm., and is quite worn. An additional Sulu male in the American Museum, apparently not measured by Gilliard, has a wing of 160 mm. Thus, with three males measuring 154+ (worn), 160, and 165.5 mm., Gilliard's specimens do not differ significantly in size from those measured by Meinertzhagen, and *suluensis* is seen to differ from *yamamurae* both in wing and in tail length.

Although I cannot see all of the clinal tendencies listed by Rand (*op. cit.*: 592), certainly enough are present to make quite difficult a realistic and practical subdivision of this species in the Philippines. I suggest the following arrangement as perhaps the best compromise:

- (1) *Oriolus chinensis chinensis* Linnaeus. Synonyms ?*fugaensis* Gilliard, *sorsogonensis* Gilliard, *palawanensis* Tweeddale. Luzon and adjacent islands; Palawan. Although placed as a synonym of *chinensis*, "*sorsogonensis*" of southernmost Luzon, together with the birds of Mindoro and Marinduque, are regarded as intergrades toward the next race.
- (2) *O. c. yamamurae* Kuroda. Yellow forehead band narrower, less yellow on tips of central rectrices and (usually lacking completely) on secondaries. Samar (including Buad), Leyte, Mindanao, Basilan. A male from Tablas resembles *chinensis* in extent of yellow on tips of rectrices, but is otherwise typical of *yamamurae*. I have not critically examined specimens from the row of islands extending southeast from Panay to Bohol, which probably belong here.
- (3) *O. c. suluensis* Sharpe. Similar to *yamamurae*, but wing somewhat and tail decidedly longer; extent of yellow on outer rectrices greater. Sulu Archipelago.

The female from Buad is in heavy body molt. Rand and Rabor (1960: 413) list only Steere as having collected *Oriolus chinensis* on Samar, but the American Museum of Natural History has a specimen collected by Whitehead at Bonga, Samar, June 6, 1896. presumably the one listed by Ogilvie-Grant (1897: 222). This record was also overlooked by McGregor (1909: 695).

*Corvus macrorhynchus philippinus* Bonaparte. Large-billed Crow.  
22382 (406) ♂ June 16.

This species is quite uniform within the Philippines. I have examined specimens from Luzon, Samar, Leyte, Negros, Panay, Mindanao, and Sibutu, and have found no variation correlated with distribution.

#### SUMMARY

A collection of 38 specimens (23 species), from the Philippine island of Buad, and now in the Royal Ontario Museum, is here listed for the first time. Previous references in the literature have erroneously credited this collection to the island of Leyte. Buad is faunally and geographically part of Samar. Of one species, *Ninox philippensis*, the specimen reported here is the only one from Samar known to be extant. Critical taxonomic studies of the following species are presented: *Ducula aenea*, *Pycnonotus goiavier*, *Hypsipetes philippinus*, *Macronus striaticeps*, and *Oriolus chinensis*. Additional taxonomic remarks and notes on molt and distribution are presented for other species.

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THE *NEOCORBICULA* (MOLLUSCA, PELECYPODA)  
OF THE PARANA-URUGUAY BASIN, SOUTH AMERICAJUAN J. PARODIZ  
Curator of InvertebratesCarnegie Museum  
andLISE HENNINGS  
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## INTRODUCTION

The Corbiculidae are represented in the southern Neotropical region by the genus *Neocorbicula*, ranging from the Guianas to La Plata River. Since the time of the early descriptions, two fundamental specific types with limited synonymy have been recognized: *Corbicula limosa* (Maton) and *Corbicula paranensis* (d'Orbigny). Subsequently more than 20 new descriptions, under the generic name *Corbicula*, have been made from that area. Due largely to a paucity of materials, these descriptions often were based on a single individual, and without recognition of the variable, intermediate forms. Though the investigator honestly may have thought he was dealing with new species, frequently from the same locality, he was actually describing samplings of one variable species. The purpose of this paper is to re-establish the concept and taxonomy of *Neocorbicula* by reducing the number of nominal species to simple variations of the fundamental types.

All the nominal species of the Paraná-Uruguay river system can be incorporated easily into three groups: *limosa-paysanduensis-paranensis*. Extensive variations occur within each group, but between the first two, *limosa-paysanduensis*, there is a continuity great enough to warrant a taxonomic lumping according to the morphological, embryological, and geographical characteristics of the material at hand.

Collections were made by the senior author from March to May, 1961, covering an area of 600 miles from north to south, including type localities. Additional material, which the authors gratefully acknowledge, was received from Dr. A. A. Bonetto of Santa Fe, Argentina, and from

the Malacological Society of Uruguay [all at Carnegie Museum (CM)]. Type lots of nominal species were observed in the Museum of Comparative Zoology (MCZ) at Harvard University and in the United States National Museum (USNM) collection. To their respective curators, Dr. William J. Clench and Dr. Harald A. Rehder, the authors extend their thanks. This research was supported by a grant, NSF-15032, to the senior author.

#### POPULATION STRUCTURE

Variability in *Neocorbicula* is less within lots or colonies than among them. The condition of viviparity, which in previous works was not clearly defined or understood in its taxonomy; the limitations of individual dispersal and the concept of random drift are significant in explaining this pattern of variation. The individuals in each colony are small in number and differ from those in neighboring colonies. But the differences, a consequence of pure breeding lines, are not taxonomically measurable.

Self-fertilization has not been proved experimentally, but all observations suggest that it is, perhaps, the normal sexual behavior in *Neocorbicula*. Like other hermaphroditic bivalves, and especially the members of the same superfamily Sphaeriacea, *Neocorbicula* incubates its embryos in the marsupial gill, and the larval stage is suppressed or at least extremely reduced in duration. These conditions can be classed within what Coe defined as "functional hermaphroditism." No pure males were found among the specimens observed. All specimens that were collected alive, and others well preserved, contained embryos of different sizes. Specimens not fully grown (half the size of the average adult) contained embryos in an advanced stage, indicating that fertilization must begin at a very early age in the individual. This suggests a long incubation period. Examination also showed that even the smaller embryos are exact replicas of the other individuals in the same microdeme. Furthermore, if the parental individual presents radiating stripes on the shell, the embryos have exactly the same number of rays. Such a condition would, presumably, not occur if true cross-fertilization had taken place.

Since the young are born alive, and are neither dispersed as eggs or larval forms nor carried by hosts, all young from one parent begin sedentary life at the same place or within a very small surrounding area. The reproduction, habits, and limited dispersion of the individuals during their lifetimes result in the formation of small breeding aggregations which can be equated with distinctive isolated populations or micro-

demes, although they are part of a widely distributed species. This partial isolation, however, is not great enough, nor has it been in operation long enough, to result in different species or subspecies. Although it is not conclusively known whether or not *Neocorbicula* occurs in populations small enough for genetic drift to be entirely effective, the patterns of variation and life conditions suggest that this is the case. The different demes, even the closest ones, form clones, not clines. Evidently this specific, mosaic-type polymorphism is not strictly ecological, because broadly similar forms occur in similar or different habitats, whether adjacent or widely separated, and different forms occasionally occur at localities having identical conditions. Sometimes two easily distinguishable demes are separated by only a few score yards. The concept of allopatry to justify subspecies is not applicable here.

**HABITATS:** The habitats of *Neocorbicula* in the Paraná and Uruguay rivers show the same opposite-shore difference in substratum. On the west margin (Entre Ríos) of the Uruguay River are sand bars of considerable extent, while the east (Uruguayan) shore is muddy. The deep substratum of the river is eruptive basalt, outcroppings of which produce graded falls and rapids, especially in the Concordia-Salto zone.

Similar conditions occur in the upper Paraná River in that portion dividing the province of Corrientes (Argentina) from Paraguay. The lower Paraguay River crosses the low lands of the southern Chaco, meeting the Paraná at a point that constitutes a great continental depression holding extraordinarily thick sediments.

The geological history of the Paraná-Paraguay river system is not fully known. It is believed, however, that before a Pliocene-Pleistocene modification of the system (renovating an old geological fracture in the direction the rivers run today), the Paraguay probably ran north. It is also possible that during the middle Tertiary both rivers emptied into an epicontinental sea covering the Chaco region, and that the Paraná-Uruguay systems were united. Such circumstances would account for the present faunistic similarity of the three rivers.

The bottom of La Plata River (actually an estuary) is formed of hardened early Pleistocene sediments of calcium carbonate and silica (locally known as *tosca*) covered by accumulations of silt and sand. Silt deposits are characteristic of the western, or Buenos Aires, bank, while sand beaches are more typical of the Uruguayan shore. Sand also occurs in an elongated bank along the center of the narrower section of the river and at its wide opening.



Fig. 1 Distribution of *Neocorbicula* in the Paraná-Uruguay basin.



## SYSTEMATIC REVIEW

## Family CORBICULIDAE

In the Americas only two genera of this family were recognized initially: *Corbicula* Megerle, 1811, with *Tellina fluminalis* Muller as the type (a synonym of *T. fluminalis* Muller is *Cyrena* Lamarck, 1818, the species placed by most authors under *Cyrena*, *sensu stricto*, now belonging to *Geloina* Gray); and *Polymesoda* Rafinesque, 1820, with *Cyclas caroliniana* Bosc as the type. But *Corbicula* is actually from the Old World and was introduced into the United States less than a decade ago. In South America both genera are replaced by *Neocorbicula* Fischer, 1887, a name first proposed as a "section" or subgenus of *Corbicula*, with *Cyclas variegata* d'Orbigny (= *Tellina limosa* Maton) as the type. *Cyanocyclus*, of various authors, proposed to replace *Corbicula*, has the same type. Therefore the type designation by Dall, 1903, is not valid, and is a synonym.

Pilsbry and Bequaert (1927) indicated that this family [Cyrenidae] is "oviparous as far as known." If that is correct for the African species studied by these authors under *Corbicula*, then they are remarkably different from the South American *Neocorbicula*, which is viviparous. Taking into account other characters, such as the presence of a pallial sinus, a generic separation is more appropriate. Of course, further observations on the African *Corbicula* may reveal viviparity. On the other hand, the Asiatic clam, *Corbicula fluminea*, has had a phenomenal spread since its recent introduction into the southwestern United States. It is now established from Florida to the Ohio River as far as Cincinnati, and has been collected in astounding quantities. Agglomerations of dead shells have clogged the intake at water-treatment plants, creating a serious problem. These fast-growing populations of *Corbicula* are in strong contrast to the microdemes of *Neocorbicula*. The young of *Corbicula* are discharged into the surrounding water in a less advanced stage and in great quantities, while in *Neocorbicula* the average number of embryos for each maternal individual is about 20. Their incubation, furthermore, is apparently uncommonly long, and the little clams are not born until fully developed, not having the late larval benthic stage of *Corbicula*.

*Polymesoda* is distinguished from *Neocorbicula* by having larger and heavier shells with stronger hinges, and by lateral teeth that are not crenulated but that sometimes have a rugose area on the upper surface. *Polymesoda* has a pallial sinus, present also in *Neocorbicula* but not in



*Corbicula*, and this is perhaps the most conspicuous difference between the Old and New World groups. Crenulation of the lateral teeth is valuable as a feature distinguishing, in general, the southern South American species from *Polymesoda*, but there is probably a transition among certain species of the western side of the Andes. *Corbicula chilina* Prime, a very rare species from Chile (apparently only a single specimen, MCZ 176883, is known; see Johnson, 1959, pl.6, fig.6) is an example.

Most of the species listed by Prime, 1865, under *Corbicula* fall in the *Neocorbicula* category. Those mentioned as *Cyrena* fall under *Polymesoda*, ranging from the southeastern United States and California through Central America into north-northwestern South America, and probably as far as Bolivia and perhaps Chile. All this requires confirmation. No true *Polymesoda* are known from the eastern or central part of South America south of the Amazon.

#### Genus *Corbicula* Megerle, 1811

*Cyanocyclus* "Ferussac" Blainville, 1811.

*Cyrena* Lamarck, 1818.

*Eucorbicula* Fischer and Crosse, 1900.

Lateral teeth lamelliform and narrow with close, minute, taxodont-like crenulations. Pallial line entire. External sculpture concentric. Interior white or violaceous. Animal with two short siphons. Africa, Asia, and southern Europe. Introduced in U.S.A.

#### Genus *Neocorbicula* Fischer, 1887

*Cyanocyclus* of authors, in part.

Shell has a pallial sinus; longer siphons ( $\frac{1}{3}$  to  $\frac{1}{4}$  inch in live specimens); equilateral, tri- or subtrigonal, concentrically striated. Pericstracum green or yellow-greenish. Internally dark violet in color. Viviparous. Eastern South America.

Prime in his two catalogues (1863 and 1895) listed only six species of *Corbicula* for America:

<i>C. limosa</i> Maton (= <i>variegata</i> , <i>semisulcata</i> , <i>perplexa</i> )	Uruguay
<i>C. cuneata</i> Jones	Orinoco
<i>C. convexa</i> Deshayes	Mexico[?]
<i>C. rotunda</i> Prime	Surinam
<i>C. paranensis</i> d'Orbigny	Paraná R.
<i>C. obsoleta</i> Deshayes (only in 1895)	Uruguay

Fischer and Crosse (1901) expressed serious doubts about the authors' identification of *convexa* as from Mexico (the specimen in Deshayes' collection had a label, "Río de la Plata"). In fact, the figured specimens are very close to some in our series of *limosa* and probably *convexa* is a synonym.

*Corbicula cuneata* and *rotunda* from the Guianas are beyond the scope of the present study. *C. obsoleta* is an intermediate form, between *paranensis* and *limosa* (closer to the second), of which we know only the type lot: MCZ 176912; see fig. 7H-J. *C. brasiliiana* Deshayes, from Pará, Brazil, was included by Prime in his "Monograph" (1865: 7) but not in his "Catalogue" (1895), perhaps because identification was impossible. According to Reeve (1878: fig. 79), it is close to *guahybensis* Marshall, that is, in the *limosa* group.

Prime's catalogues agree closely with Deshayes' "Catalogue of Conchifera or bivalve shells in the collection of the British Museum" [1854 (2): 230-232], except that the French author separates *variegata* from *limosa*. This catalogue also indicates that no specimens of *limosa* or *paranensis* existed at that time in the British Museum collection. The types of these species are considered lost. The "types" of the synonyms *variegata*, *perplexa*, and *semisulcata* in the Museum of Comparative Zoology mentioned by Johnson (1959) do not qualify here as lectotypes of *limosa*, as they do not belong to the original type-lots of these synonyms. All came, as the oldest labels accompanying them clearly indicate, from the locality of Fray Bentos, Uruguay, and the labels are all written by the same hand. Although Prime, Deshayes, and Johnson referred vaguely to South America, none mentioned Fray Bentos. Therefore a neotype of *limosa*, which agrees with Maton's description, is here selected from La Plata River, south of Buenos Aires city at the mouth of the Arroyo Las Piedras (formerly Dominico) [Parodiz Coll. 1961, CM 61-262; dimensions: length 31.8 mm., width 22.8 mm., diameter 14 mm. (see fig. 7A-E)].

Also the neotype of *Corbicula paranensis* is here selected from the Arroyo Malabrigo, near Romang, 5 miles west of the main course of the Paraná River, Department San Javier, Santa Fe, Argentina, collected by Dr. A. A. Bonetto, October, 1952, CM 61-255 [Dimensions: length 14 mm., width (or height) 13.2 mm., diameter 10.2 mm. (fig. 7A-C); 110 neoparatypes from very small (4.5 mm.) to 15 mm.].

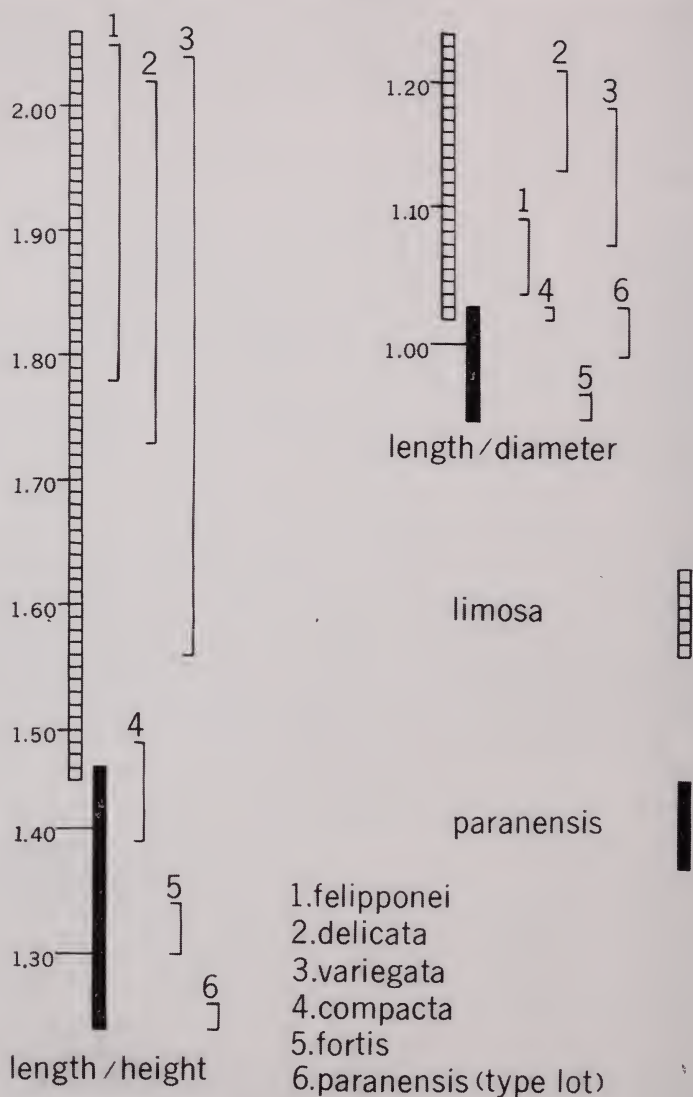


Fig. 2 Range of ratios: length/diameter and length/height.

## LIST OF THE NOMINAL SPECIES OF SOUTH-AMERICAN "CORBICULA"

- amazonica* "Anthony" Prime. Ann. Lyc. Nat. Hist. New York, 9. 1870.  
Amazon River.
- approximans* Preston. Ann. and Mag. Nat. Hist., (8) 13:528. 1914.  
Río Bermejo, N. Argentina.  
= *limosa*.
- bavayi* Ancey. Le Naturaliste, 42:334. 1880. (See also G  ret, Journal de Conchyliologie, 57:14. 1909.)  
Mara  n River, Cayenne, French Guiana.
- bermejoensis* Preston. Ann. and Mag. Nat. Hist., (8) 13:528. 1914.  
R  o Bermejo, N. Argentina.  
= *paranensis*.
- brasiliانا* Deshayes. Catalogue Conchifera British Museum, 1854 (2): 232.  
Par  , Brazil.  
probably *guahybensis*.
- circularis* Marshall. Proc. U.S. Natl. Mus., 66 (15):3, pl. 2, figs. 1-3. 1924.  
Uruguay River.  
= *paranensis*.
- coloniensis* Pilsbry. Proc. Acad. Nat. Sci. Philadelphia, 48:562, pl. 26, fig.9. 1896.  
La Plata River, Colonia, Uruguay.  
= *limosa*.
- compacta* Marshall. Proc. U.S. Natl. Mus., 66 (15):4, pl.2, figs. 10-12. 1924.  
Arroyo Sacra, Department of Paysand  , Uruguay.  
= *paranensis*.
- cuneata* Jonas. Zeitschr. f  r Malakozool., 1844:186.  
Orinoco River.
- delicata* Marshall. Proc. U.S. Natl. Mus., 66 (15):4, pl.2, figs. 4-6. 1924.  
Paysand  , Uruguay.  
= *limosa*.
- erosa* Deshayes. Proc. Zool. Soc. London, 22:354. 1854. (See also Reeve's fig.46. 1878.)  
Type loc. unknown.  
= ?*paranensis*.
- exquisita* Marshall. Proc. U.S. Natl. Mus., 66 (15):5, pl.1, figs. 9-10,12. 1924.  
Colonia, Uruguay.  
= *limosa*.
- feli  pponei* Marshall. Proc. U.S. Natl. Mus., 66: (15):6, pl.1, figs. 1,7,11. 1924.  
R  o Uruguay, Nueva Palmira, Colonia, Uruguay.  
= *limosa*.
- fortis* Marshall. Proc. U.S. Natl. Mus., 66 (15):7, pl.2, figs. 7-9. 1924.  
Colonia, Uruguay.  
= *paranensis*.

- guahybensis* Marshall. Proc. U.S. Natl. Mus., 72 (3):4, pl.1, figs. 9-10. 1927.  
Guahyba River, Río Grande do Sul, Brazil.  
= *limosa*.
- iheringi* Marshall. Proc. U.S. Natl. Mus., 72 (3):6, pl.1, figs. 11-12. 1927.  
São Leopoldo, Río Grande do Sul, Brazil.  
= *limosa*.
- incrassata* Deshayes. Proc. Zool. Soc. London, 22:342. 1854.  
Type loc. unknown.  
= *cuneata*.
- limosa* Maton. Trans. Linnean Soc. London, 10:325, pl.24, figs. 8-10. 1809. Since it was described with "*Mya variabilis*" (*Diplodon variabilis*), the type locality is probably La Plata River.
- obsoleta* Deshayes. Proc. Zool. Soc. London, 22:343. 1854.  
Uruguay.  
= *limosa*.
- oleana* Marshall. Proc. U.S. Natl. Mus., 66 (15):8, pl.1, figs. 2-4. 1924.  
Arroyo Malvin, Montevideo, Uruguay.  
= *paranensis*.
- paranacensis* d'Orbigny, 1835:44  
= *paranensis*.
- paranensis* d'Orbigny. Voyage dans l'Amerique Méridionale, p. 567, pl.83, figs. 23-25. 1846. Paraná River "from Buenos Aires to above Corrientes."
- paysanduensis* Marshall. Proc. U.S. Natl. Mus., 66 (15):9, pl.1, figs. 5,6,8. 1924.  
Paysandú, Uruguay.
- perplexa* Prime. Monograph American Corbiculidae, 7:75, fig. 84. 1865.  
"South America."  
= *limosa*.
- platensis* Marshall. Proc. U.S. Natl. Mus., 72 (3):6, pl.1, figs. 7-8. 1927.  
Colonia, Uruguay.  
= *limosa*.
- rotunda* Prime. Proc. Acad. Nat. Sci. Philadelphia, 1860:80.  
Surinam.
- semisulcata* Deshayes. Proc. Zool. Soc. London, 22:343. 1854. Victoria River, Australia! [error] South America after Prime.  
= *limosa*.
- simplex* Marshall. Proc. U.S. Natl. Mus., 72 (3):3, pl.1, figs. 3-4. 1927.  
Colonia, Uruguay.  
= *limosa*.
- surinamica* Clessin. Conchilien-Cabinet. Cycladeen, 1879:178, pl. 31, figs. 7-9.  
Surinam.
- teisserei* Marshall. Proc. U.S. Natl. Mus., 72 (3):2, pl.1, figs. 1-2. 1927.  
Colonia, Uruguay.  
= *limosa*.



*variegata* d'Orbigny (as *Cyclas*). Magasin de Zoologie, 1835:44; Voyage dans l'Amerique Méridionale, 1846:567, pl.82, figs. 14-16. The plates are labeled *limosa*!

"Rivers of Uruguay and Buenos Aires."  
= *limosa*.

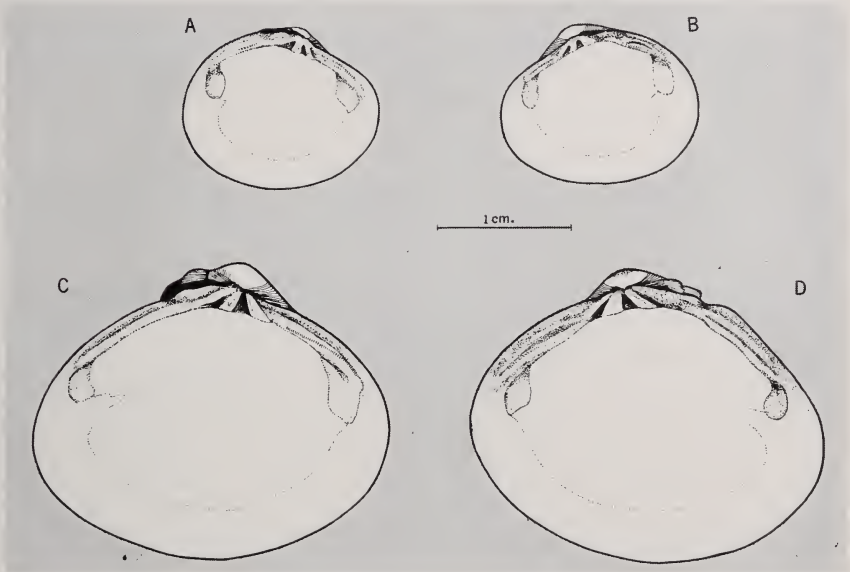


Fig. 3 *Neocorbicula limosa*. A, B. Variation representing the cline *delicata*—*paysanduensis*—*exquisita*. C, D. Typical *limosa*, showing one prominent type of teeth arrangement.

### *Neocorbicula limosa* (Maton)

Figures 3, 4, 5, 7D-J, 9A-E

*Tellina limosa* Maton, 1809.

*Cyrena variegata* d'Orbigny, 1835.

*Corbicula semisulcata* Deshayes, 1854; *perplexa* Prime, 1865;  
*coloniensis* Pilsbry, 1896; *approximans* Preston, 1914.

*Corbicula* (*Cyanocyclas*) *delicata*, *exquisita*, *felipponei*, *paysanduensis*  
all Marshall, 1924; *teisserei*, *simplex*, *guahybensis*, *iheringi*, *platensis*  
all Marshall, 1927.

Original description (translation):

"Shell equivalve, oval, transversely striated, purplish inside, umbo acute and prominent. In fresh-water of America austral . . . Shell brittle, smooth, epidermis green, integral margin. Fig. 10 larger, lighter colors inside and outside, semi-translucent."

Figures 8 and 9 accompanying Maton's description show very regular striae of growth, with characteristic colors: greenish outside, dark purple-violet inside (the same coloration, with variations, occurs in all the forms shown as different species) but no indication of rays or darker bands is given. In the same figures the shell is rather oval, with the anterior margin more rounded and the posterior somewhat truncate above and angulose below. Actually no specimen shows such a sharp outline, except perhaps in *obsoleta* Deshayes, judging from Reeve's figure 85, and part of the "type lot" (MCZ 176912; see fig. 7H-J). This may prove that it belongs to *limosa* but represents a degree of relationship with *paranensis*.

D'Orbigny's description of *Cyclas variegata* (translation):

"Shell oval-elliptical, compressed, light-weight, concentrically striated, periostracum greenish-brown; anterior margin short, rounded; lateral teeth narrow and crenulated; rays violet to greenish; inside white to violet. Dimensions: length 24 mm.; in relation to the length: height 83/00 [19.5 mm.], diameter 50/00 [12 mm.]; apical angle 105°. The shell is well distinct from the preceding [refers to *C. paranensis* in "Voyage"] in shape, its sides being less truncate, and by the colors. It is found in the sand in innumerable quantities in all the rivers of Uruguay and Buenos Aires. The animal is bluish, the ovaries violet, and the siphons yellowish. The branchial tube is ciliated."

Prime's description of *Corbicula limosa*:

"Shell transverse, ovate-elliptical, inequilateral, compressed, somewhat tumid, comparatively solid, anterior side narrower, posterior shorter, subtruncated; striae irregular: epidermis greenish; valves rather strong, inside white or of a deep violet; beak tumid, inclined toward the interior; hinge margin broad, with three unequal teeth; cardinal teeth diverging, the principal ones bifurcated; lateral teeth nearly equal in length, narrow serrulated; pallear impression terminating posteriorly in a small trigonal sinus. South American in the rivers of Eastern Uruguay. Dimensions: long. 22 mm., lat. 18 mm., diam. 13 mm."

The following, complementary description is based on all the specimens examined: Shell oval or subtriangular to posteriorly shortened (anteriorly produced), variably inflated within wide extremes and gradations; clothlike periostracum (under microscope) with or without wrinkles, shiny or dull; striations ranging from coarse to fine and separated, sometimes in the same shell (fig. 7E); outer color greenish or

tan to black; stripes (rays) strong, definitely absent, or intermediate; inner color violet, dark purple, white or pinkish orange; within pallial line heavily to lightly clouded; pallial sinus more deeply cleft in oval and posteriorly shortened specimens (stripes on these intermediate or definitely absent) than in the inequilateral-subtriangular specimens (stripes on these often are well marked); pallial sinus may be poorly marked; lateral teeth almost flat to high (fig.7D).

DIMENSIONS				
	Length	Height	Length/Height	Length/Diameter
			Ratio	Ratio
Range	8.1—33 mm.	6.1—28 mm.	2.04—1.45	1.25—1
Mean	20.5 mm.	17.1 mm.	_____	_____

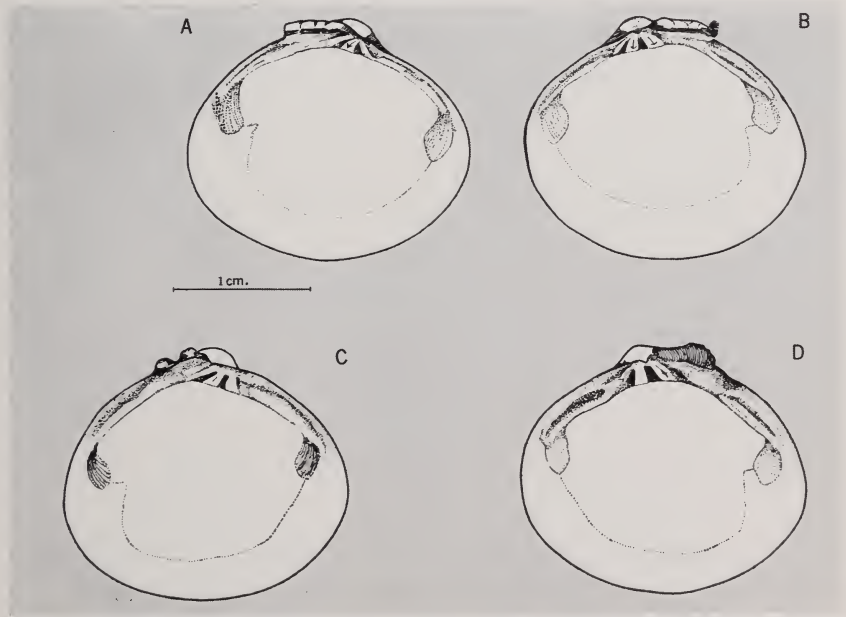


Fig. 4 *Neocorbicula limosa*. A,B. A second type of teeth arrangement. C,D. A third type of teeth arrangement.

REMARKS: Many descriptions and illustrations were of such general nature that confusion ensued, with different forms used as “type.” Thus *Tellina limosa* Maton and *Cyrena variegata* d’Orbigny (= *Cyclas* in

1844) were made into one group by Prime. D'Orbigny himself appears to have been uncertain concerning the identity of his *C. variegata* as the illustrations of it ("Voyage," pl. 83, figs. 14-16) bear the name *Cyclas limosa*, and its description fits Maton's *limosa* except for the stripes. This situation Marshall ignored or was unaware of when he proposed as new species, *teisserei*, *iheringi*, *felipponei*, *guahybensis*, and *simplex*, as these five fit easily into the *limosa-variegata* complex. One of the reasons for Marshall's failure to evaluate the intergradation of his species was the source of his materials. These were received from Dr. F. Felippone, of Montevideo, who sent (this also occurred with his naiades of the genus *Diplodon*) to the United States National Museum single specimens of different lots, not taken at random but specially chosen as strongly divergent within each lot, from very close localities, sometimes from the same place.

Taken individually, these specimens may seem strikingly different, but they cannot support separation when a great number of the same population area are compared. Pilsbry (1907) arrived at similar conclusions in dealing with oriental species of *Corbicula*, commenting that "Huede has attempted to name every local form, a task I believe to be practically impossible, and if accomplished, the result would be absolutely useless to any zoologist from the impossibility of again recognizing the forms."

*Corbicula limosa* can further be enlarged with the addition of Marshall's *delicata*, *exquisita*, and *paysanduensis*. Although these three forms are often readily separated from what was commonly understood as *C. limosa*, many different types of intermediates are found, and their distributions overlap; thus for the present there are insufficient data to warrant a separation. These three nominal species are so similar that collectively they may be termed the *paysanduensis* form<sup>1</sup> in contrast to the typical *limosa*, as it is sometimes useful to view *limosa* as composed of two principal forms. The name *delicata* must be eliminated because it is preoccupied by Pilsbry (1907) for a subspecies of *Corbicula nipponensis*. *Exquisita* is not descriptive of the drab specimen; *paysanduensis* is the best name for the form although other forms are found with it, at or near Paysandú.

In the collection of the United States National Museum there are three lots (203725, 128788, 171432) from Capivari, São Paulo, Brazil, which von Ihering provisorily labeled "*Corbicula capivari*," as well as *limosa*. Two other lots from Río Ribeira, São Paulo (USNM 162488),

<sup>1</sup> "Form" is here used as a neutral term without taxonomic status.

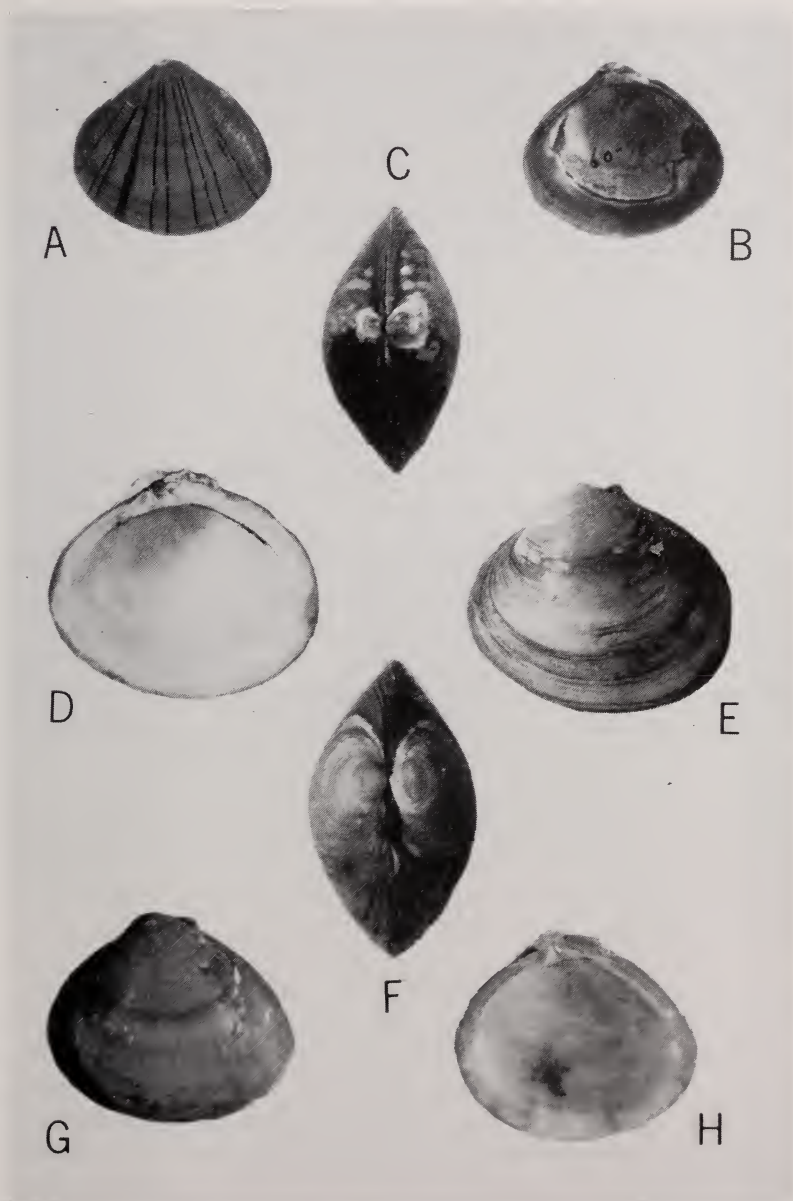


Fig. 5 *Neocorbicula limosa* (Maton). A-C. Arroyo Timote, Florida, Uruguay, CM (*variegata* of authors), A and B natural size, C x 1¼. D,E. Fray Bentos, Uruguay, MCZ, x 1½. F-H. Fray Bentos, Uruguay, MCZ (*perplexa* Prime), x 1½.



and from Iguapé, São Paulo (USNM 711424), Ihering labeled *Limosina limosa* and *Neocorbicula limosa*. It is not unreasonable to consider all these São Paulo specimens as an elongated *limosa*, within the variations already indicated. Although far away from La Plata River, São Paulo is drained principally by the Paraná-La Plata river system.

Several forms, described earlier by Prime and Deshayes, also must be considered *limosa*, since their variation does not range beyond a reasonable expectation.

**DISTRIBUTION:** *Corbicula limosa* apparently is found all along the Uruguay River. Along the southern part, below Paysandú, the typical *limosa* predominates, while the "*paysanduensis*" form occurs more frequently from Paysandú northward, especially in Misiones and the upper Paraná River. This distribution may seem disjunct, but in the northeastern part of Corrientes the land, which lies between the two rivers, has very few elevations, and swamp conditions exist almost permanently, offering a route for dispersal.

It would be of particular value to collect between Federación (Entre Ríos) and San Javier (Misiones). Data from this area would help determine better the relationships between the typical *limosa* and the *paysanduensis* form. Specifically, such a collection would help to define more sharply what *limosa* includes, because this territory appears to be part of the major area of transition. Collection on the Amazon and on the upper Paraná system would show how the specimens from northern Brazil fit in. More collecting on the Paraná between Corrientes city and Posadas, and on the Paraguay from Formosa up, would clarify the relationship with *C. paranensis* in that area of overlap. Also La Plata River would provide information on the *limosa-paysanduensis* and the *limosa-paranensis* relationships in the southern overlap.

**REPRODUCTION:** Individuals of *C. limosa* become sexually mature early, before reaching the average size of adults. Small specimens, only 9 mm. long, have been found full of embryos. Eggs are spherical, 0.5 mm. or less in diameter. A single specimen, from La Plata River, contained more than 10 embryos in the branchial pouch, measuring from 1 to 4.5 mm.; the largest was approximately one-quarter the length of the mother shell.

Embryos are incubated in the internal gills. The larger are found on the upper part of the branchiae and the smaller at the bottom of the pouch. Some embryos (the larger) were found to be breaking, or in-

serted into, the tissue of the upper portion of the gill laminae. This may be accidental, not normal.

In gravid individuals, papillae were observed on the margins of the marsupial gills and around the siphon openings.

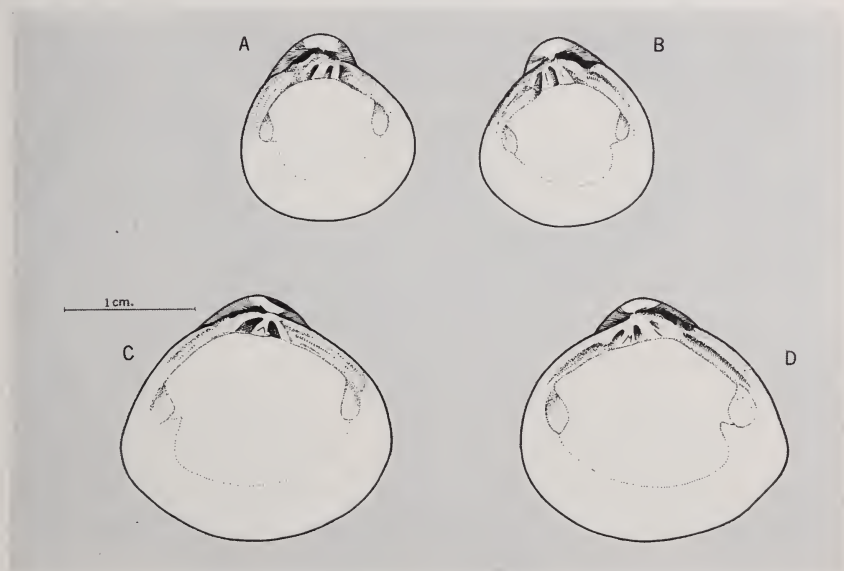


Fig. 6 *Neocorbicula paranensis*. A,B. With typical *paranensis* teeth (*C. oleana* Marsh). C. With teeth closer to *limosa* type (*C. compacta* Marsh). D. With typical *paranensis* teeth (*C. compacta* Marsh). The shape of the shells in C and D is generally similar to both *limosa* and *paranensis*.

*Neocorbicula paranensis* (d'Orbigny)

Figures 6, 7A-C, 8

*Cyrena paranensis* d'Orbigny, 1835

*Corbicula bermejoensis* Preston, 1914

*Corbicula* (*Cyanocyclus*) *compacta*, *circularis*, *fortis*, *oleana* all Marshall, 1924.

TYPE LOCALITY: "Paraná River from La Plata River to Corrientes," d'Orbigny. Here restricted as east of Romang, Department of San Javier, Santa Fe, Argentina (neotype, see p. 7).

## Original description (translation):

"Shell rounded-heart-shaped, inflated, thick, concentrically striated, epidermis yellow-greenish, anterior margin short, posterior dilated and subtruncate. Three cardinal teeth, and lateral crenulated, interior whitish to violaceous. This species is easily recognizable by its well inflated shape, fine striae, and always-uniform color without rays. It is found in the sand, under stones, at the lower level of water. It is rare. Dimensions: length 15.5 mm.; in relation to the height 87/00 [13.5 mm.]; in relation to diameter 74/00 [11.4 mm.]; apical angle  $107^{\circ}$ ."

Prime's description of *paranensis*:

"Shell small, rounded-oval, somewhat inflated, inequilateral; anterior side short, rounded; posterior side somewhat abrupt; beaks small, inclined toward the anterior; valves full, strong, interior white, striae very light, hardly visible; epidermis light-green, hinge margin rounded, thick; three cardinal teeth, unequal, divergent; lateral teeth nearly equal, the anterior one a little arched, finely striated; pallial impression terminating in a small sinus. Dimensions: long. 10 mm., lat. 8 mm., diam. 6 mm."

The complementary description follows: Shell inflated with beaks projecting beyond the hinge, coming in contact or not; periostracum thin, not very clothlike (under microscope), color tan-yellow, tan-green, brown, brown-black; stripes often absent, sometimes faintly present, and rarely obvious; striation mostly fine, although in some specimens quite coarse; inner shell white to violet; pallial sinus mostly a regular wedge shape, like an equilateral triangle (many shells are light colored on the inside, making the sinus inconspicuous); posterior margin decidedly pointed in northern forms but in most others there is at least a suggestion of this pointed margin.

## DIMENSIONS

	Length	Height	Length/Height Ratio	Length/Diameter Ratio
Range	6.1—22.0 mm.	10.1-24.0 mm.	1.45—1.25	1.03—0.95
Mean	14.1 mm.	16.1 mm.	————	————

Within *C. paranensis*, the named *fortis*, *oleana* (young of *compacta*), *circularis*, and *compacta* Marshall, plus *bermejoensis* Preston, form a gradient along the Paraná River, as seen by the representatives in the study material and as supported by the literature. D'Orbigny's figures and description most accurately apply to that phase of *paranensis* which occurs in the Arroyo Malabrigo part (see p. 7) of our study material, although he claims that it occurs along the entire river. Moving south, the forms gradually become larger and either more elongated

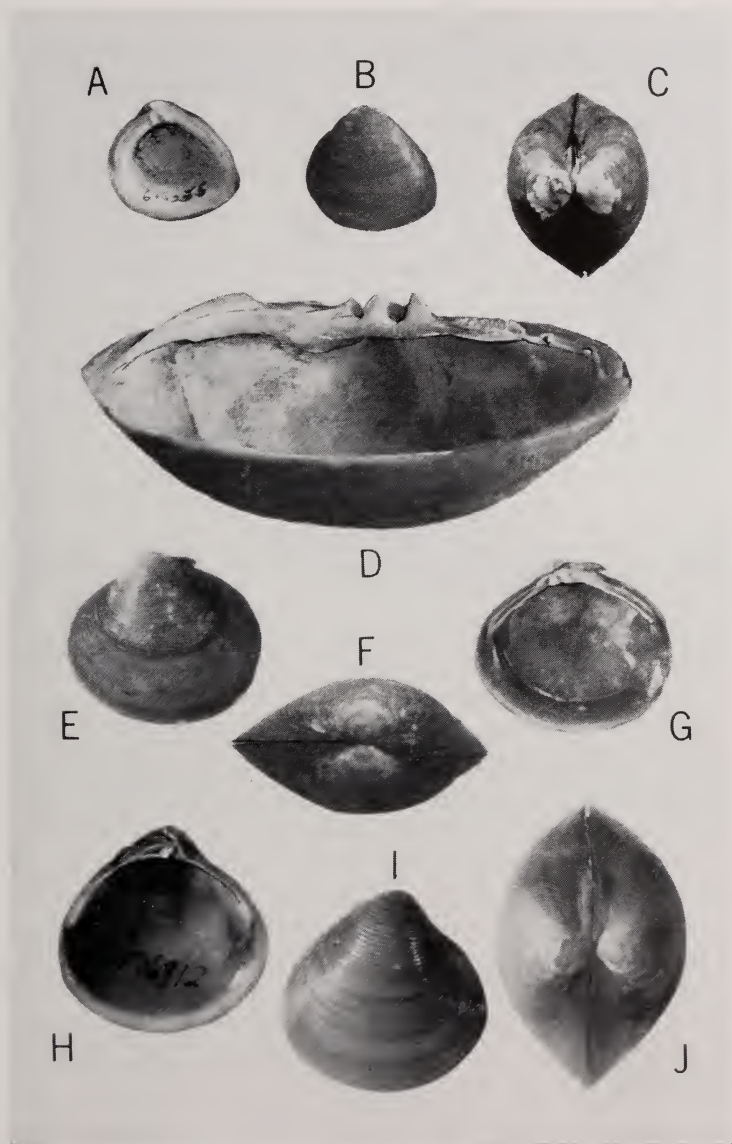


Fig. 7 A-C. *Neocorbicula paranensis* (d'Orbigny). Neotype, CM, Arroyo Malabrigo, Santa Fe, Argentina, A and B,  $\times 1\frac{1}{2}$ ; C,  $\times 2$ . D. *Neocorbicula limosa*, view of the hinge with high lateral tooth,  $\times 4$ . E-G. *Neocorbicula limosa* showing coarse and fine striation on same shell (*semisulcata* of authors), MCZ,  $\times 1\frac{1}{2}$ . H-J. Paratypes of *Corbicula obsoleta* Deshayes, (= *limosa*), MCZ,  $\times 1\frac{1}{2}$ .

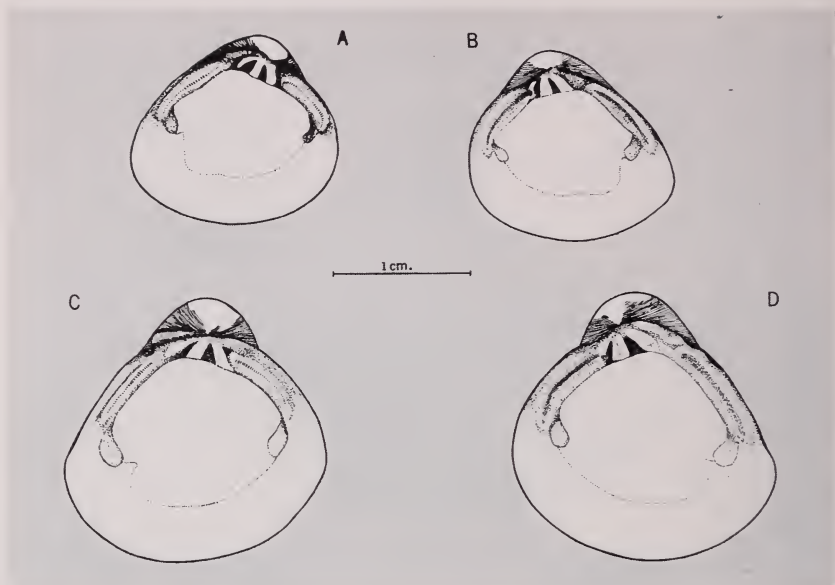


Fig. 8 *Neocorbicula paranensis*, showing typical hinges. A,B. Typical *paranensis*. C,D. (*Corbicula fortis* Marshall).

from beak to opposite edge, or more circular, with many intermediates. Almost always there is at least a hint of the posterior pointed margin. Near and in La Plata River the situation becomes more confused, with occasional specimens having characteristics of both *limosa* and *paranensis*. This suggestion of a direct relation, however, could be interpreted as mere variation of each species. The embryos are easily distinguishable. Less is known from northern areas where *paranensis* and the *pay-sanduensis* form of *limosa* overlap. Important areas for further collection would be: 1) between Santa Fe city and La Plata River; 2) between the Arroyo Malabrigo (Romang) and Formosa; 3) between Corrientes and Posadas cities.

COMPARATIVE OBSERVATIONS: In comparison with *paranensis*, *limosa* is more oval transversely and not nearly as high in proportion to the length through the beaks (*paranensis* would fit nearly into a cube; *limosa* into a parallelepipedon). In *limosa* the sinus is more conspicuous than in *paranensis*, which is predominantly white inside. Normally the



striation is heavier on *limosa*. The *limosa* embryo is similar to the adult, while *paranensis* strongly suggests the high umbos of the adult but not the whole symmetry. Also the two species do not inhabit the same area, although their distributions are not entirely disjunct. There are two regions of overlap. In the southern region there seems to be a fairly well-defined separation. Unfortunately there were not enough materials from the northern section to evaluate the overlap in that region.

Marshall stressed the importance of the teeth in specific classification. An examination of many specimens, however, shows that teeth, as well as the whole shell, present a great number of variations. Probably the most constant distinguishing characteristic is the left cardinal tooth of the right valve. In *limosa* this tooth is slender and of variable length, usually quite long and thin. In *paranensis* it is, or closely approaches, a small pyramid. The other teeth of *paranensis* are also surprisingly constant in general proportions, while those of *limosa* are quite variable in both size and shape.

Three patterns emerge as the most common arrangements of cardinal teeth in *limosa*, but not characterizing or restricted to any local form:

		TYPE I	TYPE II	TYPE III
Right Valve	R	long, slender, bifid or not	same as median	same as median (fig.4C,D)
	M	very thick, bifid	thin, bifid	rectangular, thick, not bifid
	L	long, slender, sometimes bifid (fig.3D)	smaller, long, slender	variable as I or II (fig.4B)
Left Valve	R	same as median	long, slender	same as median
	M	bifid, thick	bifid, thick, rectangular	thin, not bifid
	L	smaller, long, slender (fig.3C)	long, slender (fig.4A)	variable

Three additional arrangements were noticed:

TYPE IV: All teeth in one valve approximately the same size.

TYPE V: Median cardinals in both valves larger than other teeth.

TYPE VI: In one valve, median cardinal smaller than right tooth.

Thus, except perhaps for the left tooth in the right valve, teeth are not reliable as specific characteristics. More important characters are the over-all shape, strength, and shape of the hinge as a whole, and the relative thickness of the shell.

Striations are less important, and of least importance are color, stripes, and texture of periostracum. Many of these characters, given in description as specific (for example the violet hues inside), are of value only at the generic level, and although sometimes common to different members of the family, are not useful in identifying the species.

Nothing is known of the life span of *Neocorbicula* in absolute terms. In addition to size, the thickness of the calcified deposits inside the pallial line can be used as a rough index of age: older (that is, larger) specimens often have a proportionally thicker calcium deposit. The life cycle is imperfectly known; gravid individuals occur in collections made in spring as well as in fall. All the preserved specimens examined had embryos (including those adults of smaller size) indicating probable hermaphroditism.

#### PALEONTOLOGICAL NOTES

Several fossil species of *Corbicula* (or *Cyrena*) from South America have been described by Ihering, Fritzsche, Pilsbry, and Doello-Jurado.

"*Corbula*" *sehuena* Ihering (1907), from the Sehuen Beds of Santa Cruz (Patagonia) was first indicated as Cretaceous and now known certainly as Paleocene. *Cyrena exarata* Dunker, mentioned and figured by Fritzsche (1924) from the Puca Formation of Miraflores, Bolivia, is very similar to *sehuena*. Whether or not the two belong to a subgenus of *Corbicula* is still an open question, but both afore-mentioned strata in Bolivia and Patagonia are fresh-water and Paleocene. On the other hand, *exarata* was originally described as from Germany, which makes such identification highly improbable. Fritzsche also mentioned three other species, of the same strata, of northwestern Argentina and the adjacent region of Bolivia: *Cyrena zimmermanni* Dunker, *C. nuculaeformis* Dunker, and *C. venulina* Dunker, three names that apply to European species. Eventually they should be renamed, when better

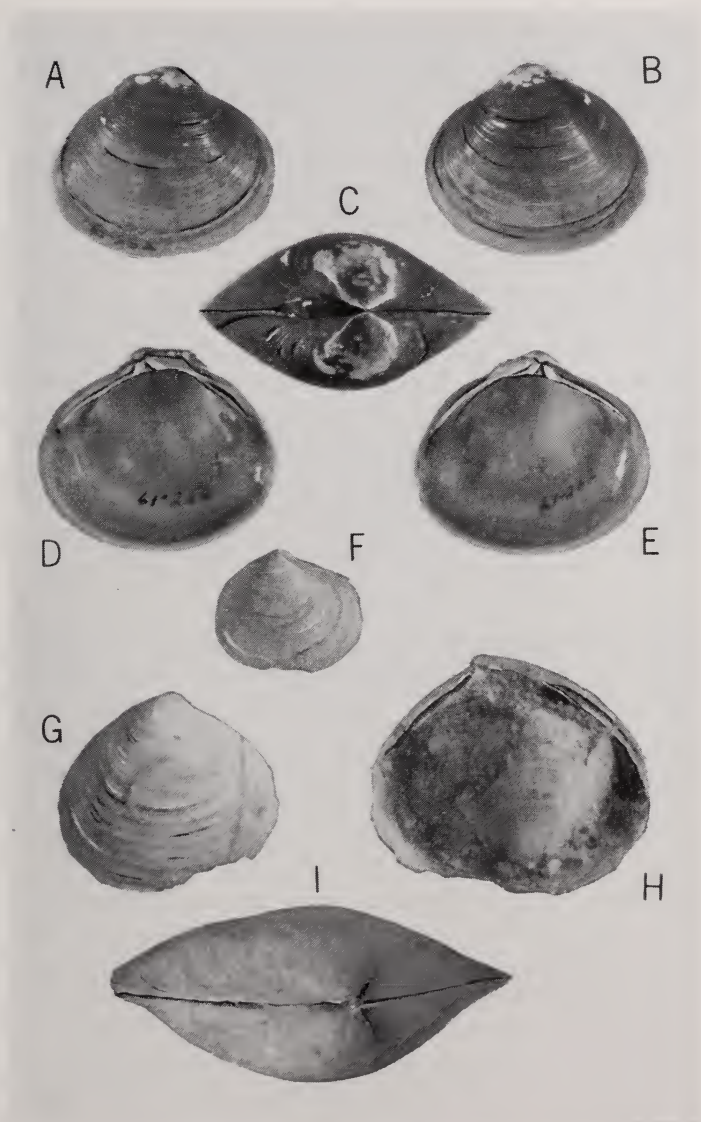


Fig. 9 A-E. *Neocorbicula limosa* (Maton). Neotype, mouth of Arroyo Las Piedras, La Plata River, CM, all  $1\frac{1}{2}$ . F. *Neocorbicula dinosaurium* (Doello-Jurado). Lower Paleocene at General Roca, Río Negro, Argentina (from type lot), CM, x 3. G-I. *Neocorbicula pehuenchensis* (Doello-Jurado). Lower Paleocene at General Roca, Río Negro, CM (from type lot). G (same specimen as H), x  $3\frac{1}{2}$ . H, x 4. I, x  $4\frac{1}{2}$ .

collections of fossil material permit a comparison with those Patagonian species of the same age. Other fossils from the Miocene of eastern Peru, although referred by Pilsbry (1944) to *Corbicula*, were not specifically named.

*Corbicula pehuenchensis* and *dinosauriorum* Doello-Jurado, both from the Paleocene of Río Negro, northern Patagonia, may be referred with more certainty to *Neocorbicula*. The type lots of both species have been observed and compared (fig. 9F-I). A valve of *C. pehuenchensis* shows a complete hinge with serrate marginals.

Ihering (1907:469) proposed the name *Corbiculella* for a subgenus of *Corbicula*. *Corbicula tenuis* Ihering (upper Miocene or lower Pliocene of Paraná, Entre Ríos) is characterized by lateral teeth that are NOT crenulated (as in *Polymesoda*), and by the ABSENCE of pallial sinus (as in *Corbicula*). In both characters the subgenus differs entirely from *Neocorbicula*. This and other fossil Corbiculidae are discussed in a special paper the author is preparing.

#### SUMMARY

The Corbiculidae of eastern South America, formerly placed in the genus *Corbicula*, are here grouped in *Neocorbicula* Fischer, 1887, with *Tellina limosa* Maton as the type. The presence of a pallial sinus characterizes both New World genera, *Polymesoda* and *Neocorbicula*, but in the former the shells are heavier and the lateral teeth not crenulated. About 40 nominal species were described before the variability and genetic relationship of the forms were understood. Of these, only two represent fundamental specific types: *N. limosa* (Maton) and *N. paranaensis* (d'Orbigny). The species of *Neocorbicula* are hermaphroditic, apparently self-fertilizing, and sexually mature at an early age. They incubate their embryos in the marsupial gill for a long time. All adults, and even the half-grown individuals observed, were gravid. Pure males were not found. On this account the populations are broken into very small and closely settled aggregations of individuals of direct line of descent, equivalent to microdemes or colonies. Each colony shows minimum variation among the individuals in the colony, but accentuates differences to other colonies, forming clones, not clines. While distant allopatric clones may repeat or duplicate certain individual characteristics, other very close, sympatric clones differ greatly. The size and structure of the populations, and the embryological characteristics, suggest genetic drift. Extensive collecting along the Paraná and Uruguay

rivers was done by the senior author from March to May, 1961. Neotypes for *N. limosa* and *paranensis* were selected and have been deposited in the Carnegie Museum collection. Fossil species from the Paleocene of Patagonia are referred, after studies of the types, to the genus *Neocorbicula*.



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## ADDITIONAL LATE EOCENE RODENTS (MAMMALIA)

## FROM THE UINTA BASIN, UTAH

MUS. COMP. ZOOL.  
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MARY R. DAWSON

MAR 10 1966

Associate Curator of Vertebrate Fossils  
Carnegie MuseumHARVARD  
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## INTRODUCTION

North American Rodentia of the late Eocene, which seems to have been a time of development of more advanced groups within this order, have been reported primarily from three areas—southern California, central Wyoming, and the Uinta Basin of northeastern Utah. Stock and Wilson, working at the California Institute of Technology (see Wilson, 1949b, for pertinent references), conducted the main studies on Californian Eocene rodents, and rodents of the Badwater area, central Wyoming, were collected and reported by Wood (1949). Early expeditions into the Uinta Basin by the American Museum of Natural History, Princeton University, and other institutions led to descriptions of some rodents from there (e.g., Osborn, 1895; Scott, 1895). Carnegie Museum's collecting activities in that area began in 1908, and rodents in this museum's collections were studied by Peterson (1919) and later by Burke (1934, 1935). Late Eocene paramyid rodents from all three areas were recently discussed by Wood (1962).

The rodents reported here are additions to the late Eocene Uinta Basin fauna. All specimens but one, which was obtained for Yale University in 1877, were collected by Carnegie Museum field parties in 1931, 1961, and 1963. These additions not only contribute to the over-all picture of the kinds of late Eocene rodents from northeastern Utah (table 1). They show, also, interesting faunal connections of this geographically-somewhat-intermediate area with the late Eocene faunas of both Wyoming and southern California.

Thanks for loans and access to collections in their care are extended to Drs. Theodore Downs and J. R. Macdonald, Los Angeles County

Museum; C. L. Gazin, United States National Museum; M. C. McKenna, American Museum of Natural History (AMNH); E. L. Simons, Yale Peabody Museum (YPM); and A. E. Wood, Amherst College. I appreciate discussions of the rodents herein reported with Drs. C. C. Black, R. W. Wilson, and A. E. Wood. Illustrations were prepared by Dr. Florence D. Wood.

Research on these rodents was supported by a grant from the Gulf Oil Corporation, and grant GB-1266 from the National Science Foundation.

TABLE 1. RODENTS FROM THE LATE EOCENE, UINTA BASIN

	Uintan		Duchesnean	
	Wagonhound	Myton	Randlett	LaPoint
Paramyidae <sup>1</sup>				
<i>Leptotomus</i>				
<i>L. leptodus</i> (Cope, 1873)	x	x		
<i>L. mytonensis</i> Wood, 1962		x		
<i>L. kayi</i> Burke, 1934			x	
<i>L. sciuroides</i> (Scott and Osborn, 1887)		x		
<i>Thisbemys</i>				
<i>T. uintensis</i> (Osborn, 1895)	x			
<i>T. medius</i> (Peterson, 1919)		x		
<i>Reithroparamys</i>				
<i>R. gidleyi</i> (Peterson, 1919)		x		
<i>Microparamys</i>				
<i>M. dubius</i> (Wood, 1949) <sup>2</sup>	x			
<i>Ischyrotomus</i>				
<i>I. petersoni</i> (Matthew, 1910)	x	x		
<i>I. compressidens</i> (Peterson, 1919)	x	x		
<i>I. eugenei</i> Burke, 1935		x		
<i>Mytonomys</i>				
<i>M. robustus</i> (Peterson, 1919)	x	x	x	
?Paramyidae				
<i>Janimus</i>				
<i>J. rhinophilus</i> <sup>2</sup>		x		
Cylindrodontidae				
<i>Pareumys</i>				
<i>P. grangeri</i> Burke, 1935	x			
<i>P. milleri</i> Peterson, 1919		x		
<i>Pareumys</i> sp. <sup>3</sup>			x	
?Pareumys				
? <i>P. troxelli</i> Burke, 1935	x			



	Uintan		Duchesnean	
	Wagonhound	Myton	Randlett	LaPoint
Sciuravidae				
<i>Sciuravus</i>				
<i>S. altidens</i> Peterson, 1919	x			
<i>S. popi</i> <sup>2</sup>	x			
<i>Sciuravus</i> cf. <i>S. popi</i> <sup>2</sup>	x			
Protoptychidae				
<i>Protoptychus</i>				
<i>P. hatcheri</i> Scott, 1895	x			
Eomyidae				
<i>Protadajdaumo</i>				
<i>P. typus</i> Burke, 1934				x
?Sciuravid or myomorph sp. <sup>2</sup> <sup>4</sup>			x	

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UNIVERSITY<sup>1</sup> Following Wood, 1962.<sup>2</sup> This paper.<sup>3</sup> Probably Burke's (1934: 391) *Tillomys* type (Wilson, 1949b: 82).<sup>4</sup> Possibly Burke's (1934: 391) *Sciuravus* type.

## SYSTEMATIC DESCRIPTIONS

## Family PARAMYIDAE

*Microparamys dubius* (Wood, 1949)

## Figures 1-3

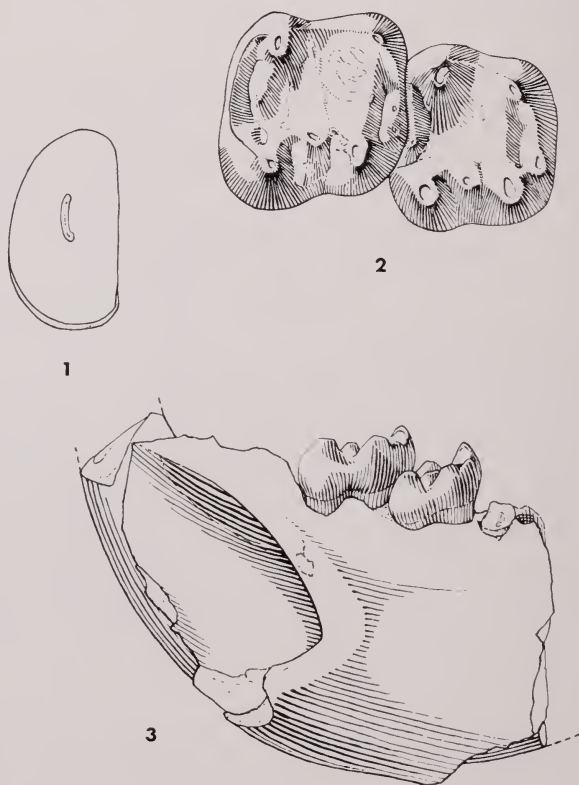
SPECIMEN: CM 14919, right jaw fragment with M<sub>1-2</sub>.

GEOLOGIC AGE AND LOCALITY: Uintan (Wagonhound member), late Eocene; badlands east of White River Pocket, Uintah Co., Utah.

*Sciuravus dubius* was described by Wood (1949: 558) on the basis of isolated teeth including M<sub>3</sub>, probable M<sub>2</sub>, and several incisors from upper Eocene deposits along Badwater Creek, Natrona County, Wyoming. Since Wood's work, more teeth of the species, representing both upper and lower dentitions, have been obtained from the Badwater deposits by Carnegie Museum field parties. Comparisons with Wood's original material and with the more recently collected specimens from Badwater, which will be described later, indicate that CM 14919 is referable to Wood's species.

DESCRIPTION: The incomplete jaw of CM 14919 (fig. 3) has a masseteric fossa extending forward to a line below the trigonid of M<sub>2</sub>; the ridge marking attachment of the masseter lateralis muscle reaches to a line below the talonid of M<sub>1</sub>. The position of the mental foramen is indicated by a notch in a line just anterior to the alveolus of P<sub>4</sub>. In

broken cross section the lower incisor (fig. 1) has a flattened medial surface, is slightly convex ventrally, and more convex laterally. The greatest width of the incisor occurs about one-third of the way up from the ventral surface. Of the two molars,  $M_2$  is unbroken, whereas  $M_1$  appears to have been crushed against  $M_2$  with resultant anteroposterior compression of the talonid, and elevation of the posterior cingulum and hypoconulid on the more anterior tooth. The brachydont molars (fig. 2) have the following characters: (1) a well developed anterior cingulum that is cusperate buccally and extends lingually to contact the metaconid; (2) a small trigonid basin closed posteriorly by metalophulid II, which reaches to the posterior flank of the metaconid; (3) a distinct mesoconid;



Figs. 1-3: *Microparamys dubius*, CM 14919, right-jaw fragment with  $M_{1-2}$ . fig. 1: Cross section of broken lower incisor, approx.  $\times 18$ . fig. 2: Occlusal view of  $M_{1-2}$ , approx.  $\times 18$ . fig. 3: Lateral view of jaw, approx.  $\times 8$ .

(4) no distinct mesostylid<sup>1</sup>; (5) a crested entoconid that is separated lingually from the posterior cingulum; (6) a long curved posterior cingulum. On  $M_1$  the trigonid is narrower relative to the talonid than on  $M_2$ . In this specimen, wear on  $M_1$  is in a stage in which a ridge connects the cusate anterior cingulum to the protoconid, whereas these structures are separated by a groove on  $M_2$ . Trigonid basin and metaconid are more compressed anteroposteriorly on  $M_2$  than on  $M_1$ . On  $M_2$  the mesoconid is ridged buccally and enamel in the talonid basin is wrinkled.

DISCUSSION: In the original description Wood (1949: 558) considered *Sciuravus dubius* closest to species of *Sciuravus*, although he discussed similarities of the new species to *Reithroparamys* and suggested that better material might require reference of the species to a new genus. Later, Wood (1959: 162) established the genus *Microparamys* for several small species of paramyids. His further studies on paramyids (1962) led to reference of several more species to that genus and recognition of some characters of *Microparamys* that suggest affinities with the Sciuravidae and others in which the genus resembles *Reithroparamys*. *Microparamys* is characterized by small size, lower molars having an anterior cingulum that tends to be isolated from the protoconid, usually well developed mesoconid, entoconid isolated lingually from the posterior cingulum, and masseteric fossa terminating below the trigonid of  $M_2$  or below  $M_1$ . *Sciuravus dubius* appears to have a general dental pattern most similar to that in *Microparamys*, and the species is accordingly referred here to that genus.

The following is an emended diagnosis of *Microparamys dubius*, based on Wood's type, topotypes, and CM 14919: microparamyine smaller than *Microparamys minutus* and *M. tricus*, larger than *M. wilsoni*; anterior cingulum cusate buccally, separated from protoconid in early stages of wear; trigonid basin closed posteriorly by anterolingually directed metalophulid II; no distant mesostylid; entoconid crested; posterior cingulum long, curved; masseteric fossa reaching to below trigonid of  $M_2$ , ridge to below talonid of  $M_1$ .

---

<sup>1</sup>The terms "mesostylid" and "metastylid" are used by Wood and Wilson (1936: 390) for lingual cusps in the talonid basin, the metastylid being more anteriorly situated. When only one cusp occurs lingually in the basin it may be difficult to determine which term is more appropriate, but "mesostylid" is used here when the cusp is more or less centrally situated in the lingual exit of the basin and "metastylid" when more clearly on the posterior flank of the metaconid.

Within the genus *Microparamys*, *M. dubius* agrees with Wood's (1962: 158) group of forms with progressive tooth patterns. Other late Eocene members of this group are *Microparamys* sp. D, and *M. tricus*, both from the late Eocene of California. In *Microparamys* sp. D,  $M_2$  is slightly larger than in *M. dubius*, metalophulid II extends farther lingual, and a mesostylid is present. *Microparamys tricus* is a larger rodent than *M. dubius*, but resembles that species among microparamyines in lacking a distinct mesostylid.

TABLE 2. MEASUREMENTS (IN MILLIMETERS) OF TEETH OF *Microparamys dubius* AND *Janimus rhinophilus*

	<i>M. dubius</i> CM 14919	<i>J. rhinophilus</i> CM 9951
$M_1$		
anteroposterior	1.2	—
width trigonid	1.15	—
width talonid	1.3	—
$M_2$		
anteroposterior	1.35	1.7
width trigonid	1.35	1.65
width talonid	1.4	1.6
$M_3$		
anteroposterior	—	1.9
width trigonid	—	1.6
width talonid	—	1.5
Lower incisor		
anteroposterior	1.6	1.9
width	0.9	1.3

#### Family ?PARAMYIDAE

#### *Janimus*<sup>1</sup> *rhinophilus*<sup>2</sup>, new genus and new species

#### Figures 4-6

TYPE SPECIMEN: CM 12005, fragment of right jaw with  $M_{2-3}$ , lower incisor.

HYPODIGN: Type only.

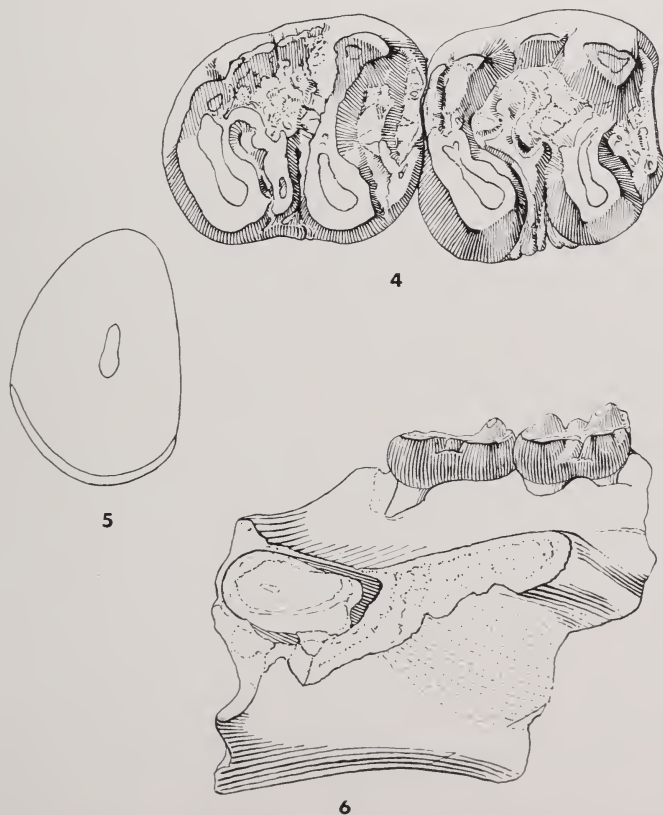
GEOLOGIC AGE AND LOCALITY: Uintan (Myton member), late Eocene; Myton Pocket, Uintah Co., Utah.

<sup>1</sup>For Janet Dawson, in appreciation of her assistance in the field work that produced this specimen, and of her other aid, direct and indirect, to field studies.

<sup>2</sup>In reference to finding this fossil rodent embedded in matrix at the bend of the knee of an amynodont rhinoceros.

**GENERIC AND SPECIFIC CHARACTERS:** Lower molars brachydont with accessory folds prominent in talonid basin; anterior cingulum, separated by groove from protoconid (in early wear), forms entire anterior edge of molars, extending linguad anterior to metaconid; metalophulid II closes trigonid basin; entoconid well developed, crested on  $M_2$ ; prominent mesostylid; mesoconid with posterolingual spur; no complete ectolophid. Incisor convex ventrally and laterally. Ascending ramus originates approximately in line with mid- $M_2$ . Size smaller than *Microparamys tricus*, larger than "*Mysops*" *kalicola*.

**DESCRIPTION:** Known cheek teeth,  $M_{2-3}$  (fig. 4), are slightly worn but their occlusal pattern remains evident. A well developed anterior cingulum, buccally separated by a groove from the protoconid, forms the entire anterior edge of these teeth, and at its lingual end curves back to



Figs. 4-6: *Janimus rhinophilus*, type specimen, CM 12005, right-jaw fragment with  $M_{2-3}$ . fig. 4: Occlusal view of  $M_{2-3}$ , approx.  $\times 18$ . fig. 5: Cross section of broken lower incisor, approx.  $\times 18$ . fig. 6: Lateral view of jaw, approx.  $\times 9$ .



contact the anterior surface of the metaconid. Thus, the metaconid is not marginal but is set back from the anterior edge of the molars. Metalophulid II closes the trigonid basin posteriorly. Within the trigonid basin an accessory ridge extends from the buccal end of the cingulum approximately to the mid-line on  $M_2$  and to the metaconid on  $M_3$ . The surface of the relatively open talonid basin is wrinkled into a number of rugosities. On  $M_2$  the well developed entoconid is crested, with the crest extending buccally and slightly posteriorly and contacting a ridge from the hypoconid that continues to the lingual border of the tooth as the posterior cingulum. On  $M_3$  the entoconid is less elevated, not crested, and contacted posteriorly by the short posterior cingulum. The teeth seem to lack an ectolophid, but have an anteroposteriorly compressed mesoconid that has a short posterolingual spur, especially prominent on  $M_2$ . Accessory cuspules occur in the valley buccal to the mesoconid. A well developed mesostylid, more raised on  $M_2$  than on  $M_3$ , blocks the lingual end of the talonid basin.

The lower incisor in broken, most anterior cross section (fig. 5) is convex ventrally and laterally with greatest transverse width slightly below mid-depth. Enamel extends up the lateral side approximately to the point of greatest width.

The jaw fragment (fig. 6) exhibits only part of the dorsal ridge bordering the masseteric fossa. A narrow trough is present between the cheek teeth and the broken basal portion of the ascending ramus, which appears to have stood out laterally from the horizontal ramus and originated approximately in line with the middle of  $M_2$ .

COMPARISONS AND RELATIONSHIPS: Presence of a distinct anterior cingulum and accessory crenulations on the lower molars of *Janimus* bring to mind these structures in teeth of the early Eocene microparamyine, *Lophiparamys murinus* (Wood, 1962: 167-169), which resembles *Janimus* also in development of the mesostylid. In detail, however, the two genera differ, with *Lophiparamys* being characterized by the following: (1) accessory crenulations of molars less coarse; (2) anterior cingulum not present anterior to marginal metaconid, which descends steeply into the more open talonid basin; (3) entoconid smaller relative to metaconid and not crested; (4)  $M_3$  more elongated, tapered posteriorly; (5) lower incisor narrower transversely. *Microparamys* likewise differs from *Janimus* in having a marginal metaconid without the lingual extension of the anterior cingulum characteristic of *Janimus*, a more distinctly paramyid talonid basin, relatively smaller entoconid,

and, in early and middle Eocene species, in lacking a transversely crested entoconid. *Microparamys tricus* and *M. dubius*, late Eocene species, parallel *Janimus* in showing some development of the entoconid crest. Although *Microparamys* sp. D (Wood, 1962: 165-166) differs from *Janimus* in most of the same characters as do other species of *Microparamys*, it shows interesting similarities to *Janimus* in having traces of crenulated enamel in the talonid basin, and a long metalophulid II.

The relatively well developed entoconid and its crest on  $M_2$  in *Janimus* are suggestive of somewhat corresponding lower molar structures found in sciuravids. Sciuravids typically have even greater development, on  $M_3$  as well as  $M_2$ , of the entoconid and entoconid crest, with an essentially obliterated talonid basin, and lack the anterior cingulum characteristic of *Janimus*. A short anterior cingulum occurs in the very small sciuravid, *Pauromys*, but the mesolophid, more closed talonid basin, short posterior cingulum, and other features of this genus clearly separate it from *Janimus*.

The early Eocene (Lost Cabin) "*Mysops*" *kalicola* (Matthew and Granger, 1918: 618-619) is a rodent whose relationships have long been uncertain. Although generally recognized at present as not closely related to the cylindrodontid genus *Mysops*, familial affinity of the species has not been established. For example, Wilson (1949b: 79, 90-91) favored referring it to the Paramyidae (then Paramyinae), although recognizing trends in the entoconid cresting of "*M.*" *kalicola* toward sciuravid and cylindrodontid characteristics. And Wood (1962: 168, fig. 90) has regarded the species as a sciuravid possibly related to the microparamyine *Lophiparamys*. The type specimen of "*Mysops*" *kalicola*, AMNH 14731, right jaw with  $P_4$ - $M_2$ , can be compared with *Janimus* only in  $M_2$  and a few features of the ramus.<sup>1</sup> Points of resemblance of "*M.*" *kalicola* to *Janimus* are found in the following characters: (1) anterior cingulum forming entire anterior edge of molars and extending to the lingual border anterior to the metaconid, although the metaconid is not set back so far as in *Janimus*; (2) long metalophulid II; (3) entoconid nearly as well developed and distinctly crested; (4) short spur from mesoconid into talonid basin. "*Mysops*" *kalicola* has crenulations in the enamel of the talonid basin, although these are not as promi-

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<sup>1</sup>Matthew and Granger's figure of "*M.*" *kalicola* (1918: fig. 38) shows  $M_3$  taken from AMNH 14729, a paratype. This "paratype" does not represent "*M.*" *kalicola* and seems to be most similar to *Microparamys lysitensis*.

nent as the accessory folds in *Janimus*. Other differences from *Janimus* include the following: (1) absence of a mesostylid; (2) suggestion of an ectolophid, although this is not well developed; (3) more directly transverse orientation of entoconid crest; (4) transversely narrower incisor; (5) ascending ramus originating about in line with the middle of  $M_3$ .

As now known *Janimus rhinophilus* is a morphologically distinct late Eocene rodent having somewhat lophate lower molars with complications of occlusal pattern due to accessory folds or crenulations. Suggestion of some advance over the general paramyid and sciuravid jaw structure is indicated by the probable more anterior and lateral position of the ascending ramus. The new genus shares with microparamyine paramyids the well developed anterior cingulum and talonid basin. The lack of an entoconid crest on  $M_3$  is a further paramyid resemblance. Similarity to sciuravids is shown in the large, crested entoconid on  $M_2$ , which, however, can be found in cylindrodontids and some microparamyines as well. Of known pre-Uintan rodents, the early Eocene "*Mysops*" *kalicola* is the species most similar to *J. rhinophilus*, as shown by the anterior cingulum, crested entoconid, and traces of crenulations in the enamel, but it differs in more marginal metaconid and other details. Certainty in relationships cannot be attained until both species are known by more complete material, especially upper dentitions. But it seems reasonable that *Janimus rhinophilus* represents a line of rodent evolution derived from near "*M.*" *kalicola* and more distantly from microparamyines.

It appears that in the early Eocene several lines of mostly small-sized rodents developed cresting of the lower molars. These include microparamyines, early sciuravids, and "*Mysops*" *kalicola*. Cylindrodontids, first known from the middle Eocene might be traceable into this complex also. It is sometimes difficult to determine differences of familial magnitude within this early Eocene complex, but developments out of the early microparamyines and sciuravids led to distinct later Eocene rodent types. *Janimus*, probably derived from near "*M.*" *kalicola*, retained the relatively open talonid basin of paramyids, and shows other similarities to microparamyines that lead to a tentative reference to ?Paramyidae. This tentative assignment seems to express most clearly the probable earlier affinities of this rodent and seems reasonable until the Eocene record reveals more evidence on the morphology of this late Eocene rodent and its probable earlier relative, "*Mysops*" *kalicola*.

As for resemblance between *Janimus* and later rodents, suggestive similarity is found between the pattern on the lower molars of *Janimus*

and that of an early eutypomyid from the Chambers Tuff, Vieha Group, of Texas, now being studied by A. E. Wood (personal communication). Discussion of relationships between *Janimus* and this Duchesnean or early Chadronian eutypomyid awaits completion of Wood's study.

Family SCIURAVIDAE  
*Sciuravus popi*,<sup>1</sup> new species

Figures 8-10

TYPE SPECIMEN: CM 14918, fragment of right maxilla with P<sup>4</sup>-M<sup>1</sup>, left M<sub>1</sub>, M<sub>3</sub>, postcranial fragments.

GEOLOGIC AGE AND LOCALITY: Uintan (Wagonhound member), late Eocene; badlands east of White River Pocket, Uintah Co., Utah.

HYPODGM: Type and YPM 16875, right lower molar, probably M<sub>2</sub>, from "mouth of White River, Utah" (collected in 1877; locality data are inadequate for more precise age determination than Uintan).

SPECIFIC CHARACTERS: Species of *Sciuravus* larger than *S. powayensis* and *S. altidens*. P<sup>4</sup> tending toward quadrate shape with relatively well developed hypocone; M<sup>1</sup> having loph from hypocone toward mesostyle in central valley; large mesoconid on lower molars, with short mesolophid on M<sub>1</sub>.

DESCRIPTION AND COMPARISONS: Teeth of the rodent represented by CM 14918 are well worn, but YPM 16875 is from a younger individual. The upper teeth (fig. 8) are somewhat high-crowned lingually, and on M<sup>1</sup> the groove between protocone and hypocone extends nearly to the limit of the enamel. *Sciuravus altidens*, a smaller species, is similar in having lingual hypsodonty but has a groove between protocone and hypocone that does not reach so far up the lingual wall. A wear facet on the anterior surface of P<sup>4</sup> shows that P<sup>3</sup> was present, as in other species of *Sciuravus*. A suggestion of molarization of P<sup>4</sup> is shown by its relatively well developed hypocone and somewhat quadrate shape. On P<sup>4</sup> lingual to the rounded metacone a ridgelike structure, probably a metaconule, extends essentially transversely toward the shallow groove between protocone and hypocone. In contrast, the metaconule of the more triangular P<sup>4</sup> in *S. nitidus* is directed anterolingually toward the protocone; in *S. altidens* and *S. powayensis* there is no discrete metaconule but rather a ridged metacone, which reaches anterolingually in the former and is more transversely oriented in the latter.

The only known upper molar, M<sup>1</sup>, can be distinguished from that of

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<sup>1</sup>For Dr. J. LeRoy "Pop" Kay, Curator Emeritus of Vertebrate Fossils, Carnegie Museum, in sincere appreciation of his many years of productive field work in the Uinta Basin.



other species of *Sciuravus* by a distinctive pattern of lophing from the hypocone. The hypocone has one short spur directed toward the anteroposteriorly compressed metacone and a second, more elongated loph extends in a transverse direction into the central valley. This loph stops just short of a contact with the anteroposteriorly compressed mesostyle, so style and loph do not quite make a continuous ridge in the central valley. In most other species of *Sciuravus* the anterior arm of the hypocone on M<sup>1</sup> extends anterobuccally and then swings posteriorly to contact the metacone. In *S. powayensis* the arm is short and lacks the posteriorly directed extension to the metacone. At any rate, the development of a loph in the central valley of M<sup>1</sup> is not found in other known species of the genus. Buccal to the mesostyle a small cuspule and cingulum occur in the exit of that valley.

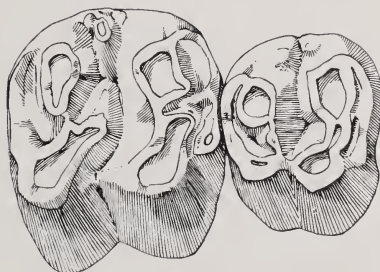
On worn M<sub>1</sub> and M<sub>3</sub> of CM 14918 (figs. 9, 10) the lingual wall of the metaconid extends posteriorly in a shelf-like ridge. The less worn M<sub>2</sub> of YPM 16875 has a distinct metastylid on the posterior slope of the metaconid that would form this ridge as wear progressed. The mesoconid is large on the lower molars and on M<sub>1</sub> is extended linguallly in a short mesolophid. A mesostylid occurs linguallly and an ectostylid, buccally on M<sub>1</sub> and M<sub>2</sub>. On M<sub>3</sub> the hypolophid extends in a posterobuccal direction to the hypoconid. This tooth in *Sciuravus nitidus* exhibits considerable variation in the crest of the entoconid. A sample of *S. nitidus* from Bridger B deposits in the collections of the United States National Museum shows the entoconid crest of M<sub>3</sub> connected to the mesoconid in some specimens, to the hypoconid in others, and toward an intermediate area in still others. Whether the condition of M<sub>3</sub> in CM 14918 is characteristic of the species or is individually variable cannot be determined on the basis of the known material. *Sciuravus powayensis* differs from CM 14918 in having the entoconid crest or hypolophid of M<sub>3</sub> swing forward toward or to the mesoconid.

RELATIONSHIPS: *Sciuravus* has been reported from deposits ranging in age from late Wasatchian (Gazin, 1962) to early Uintan (Peterson, 1919: 64-65; Wilson, 1940: 87-91). The type species, *S. nitidus*, ranges through the Bridgerian and as currently defined demonstrates considerable individual variation. Some tendency exists in geologically younger representatives of that species toward development of a mesolophid on the lower molars, and increase in size. Three Uintan species are now known, *S. powayensis* from southern California, *S. altidens* and *S. popi*, both from the Uinta Basin. Of these *S. popi* exhibits size increase be-

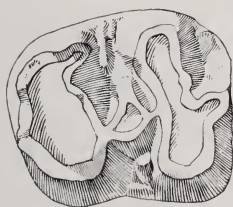




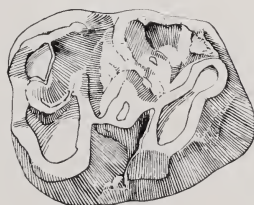
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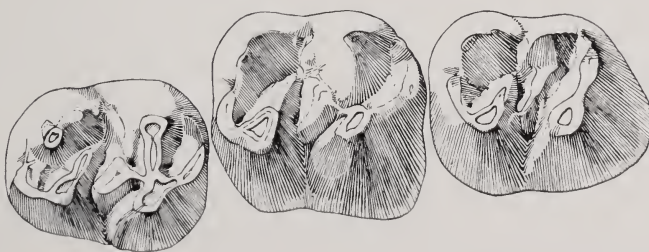
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11

Figs. 7-11: Occlusal views of rodent teeth. fig. 7: CM 9951, left upper molar, approx. x12. Figs. 8-10: *Sciuravus popi*, type specimen, CM 14918. fig. 8: P<sup>1</sup>-M<sup>1</sup>, fig. 9: M<sub>1</sub>, fig. 10: M<sub>a</sub>. fig. 11: *Sciuravus* cf. *S. popi*, CM 14920, M<sub>1-3</sub>. Figs. 8-11 approx. x9.

yond that of *S. nitidus*, possibly indicating continuation of the trend toward larger size shown by later Bridgerian specimens of the latter. Other than similarity between *S. altidens* and *S. popi* in development of some lingual hypsodonty, and between *S. powayensis* and *S. popi* in transverse orientation of the metaconule or metacone crest on  $P^4$ , the three Uintan species show few morphological details of special resemblance and it seems reasonable to interpret them as independently derived from Bridgerian *Sciuravus*.

*Sciuravus* cf. *S. popi*

Figure 11

SPECIMEN: CM 14920, fragmentary left jaw with  $M_{1-3}$ , right  $M_3$ .

GEOLOGIC AGE AND LOCALITY: Uintan (Wagonhound member), late Eocene; badlands east of White River Pocket, Uintah Co., Utah.

This specimen, found in deposits near those from which the type specimen of *Sciuravus popi*, CM 14918, was derived, represents a young individual having lower molars slightly smaller than in CM 14918 and YPM 16875 but showing a general resemblance in pattern to those specimens. In the talonid basin of  $M_1$ , CM 14920 has a small lophid seemingly not connected to the mesoconid and, more lingually, a very small mesostylid. Only faint indications of these structures, little more than crenulations, occur on  $M_2$ . Another pattern difference from *S. popi* is shown by absence of ectostylids on  $M_{1-2}$  in CM 14920. A more prominent difference from CM 14918 is exhibited by  $M_3$ , on which the crest of the entoconid extends anterobuccally, unites with the compressed mesoconid, and forms a lophid separated by a groove from the hypoconid-posterolophid. As mentioned above, among specimens referred to the Bridgerian *S. nitidus*, entoconid crests of the types found in both CM 14918 and CM 14920 occur, as well as intermediates between these types. More complete material is required, however, before it can be determined whether these two Uintan specimens represent individual variants or distinct species. Only a tentative reference of CM 14920 to *Sciuravus* cf. *S. popi* seems desirable on known specimens. Caution in reference is promoted by the possibility that CM 14920 represents the previously unknown lower dentition of the other early Uintan sciuravid from the Uinta Basin, *S. altidens*.

An interesting condition of  $M_1$  shown by CM 14920 is presence of two distinct roots below the trigonid of  $M_1$ . Usually in *Sciuravus* one sturdy root is present below the molar trigonids, with faint suggestion of separation into two parts occurring only at the very tip of that root.

TABLE 3. MEASUREMENTS (IN MILLIMETERS) OF TEETH OF SCIURAVIDS AND ? SCIURAVID OR MYOMORPH

	<i>Sciuravus popi</i>		<i>Sciuravus</i> cf. <i>S. popi</i>	? sciuravid or myomorph
	CM 14918	YPM 16875	CM 14920	CM 9951
P <sup>1</sup>				
anteroposterior	2.3	—	—	—
width	2.6	—	—	—
M <sup>1</sup>				
anteroposterior	2.9	—	—	1.7
width	3.1	—	—	1.6
M <sub>1</sub>				
anteroposterior	3.1	—	2.95	—
width trigonid	2.4	—	2.1	—
width talonid	2.9	—	2.65	—
M <sub>2</sub>				
anteroposterior	—	3.1	3.0	—
width trigonid	—	2.8	2.7	—
width talonid	—	2.8	2.9	—
M <sub>3</sub>				
anteroposterior	3.55	—	3.2	—
width trigonid	2.8	—	2.5	—
width talonid	2.8	—	2.5	—

Family *incertae sedis*  
? Sciuravid or myomorph sp.

### Figure 7

SPECIMEN: CM 9951, left upper molar, probably M<sup>1</sup>.

GEOLOGIC AGE AND LOCALITY: Duchesnean (Randlett member), late Eocene; two miles northeast of Randlett Point, Uintah Co., Utah.

DESCRIPTION: The four main cusps of this relatively low crowned, only slightly worn upper molar are well developed, and the tooth has a distinct anterior cingulum forming its anterior wall. Paracone and metacone are rounded buccally, tapered lingually. Protocone and hypocone are separated from one another by a distinct groove. A ridge extends obliquely forward from the protocone to contact the anterior

cingulum near its buccal end. An expansion on this ridge lingual to the paracone may represent a protoconule. A second ridge, approximately paralleling the first, runs obliquely forward from the hypocone; at about the center of the transverse valley of the molar this ridge divides, sending forward a short process to the base of the paracone and buccad a mesoloph almost to the buccal side. A small but distinct mesostyle occurs in the buccal exit of the transverse valley, anterior to and not in contact with the mesoloph. A posterior cingulum extends from the hypocone to the buccal side, forming the posterior wall of the tooth and separated from the metacone by a deep valley except at the posteroexternal edge of the tooth.

COMPARISONS AND RELATIONSHIPS: This single tooth is more tantalizing than edifying, but illustrates well not only the frustrations inherent in studies of isolated teeth but also the potential of late Eocene rodents. Some of its characteristics are reminiscent of the Sciuravidae, relatively primitive Eocene sciuromorph rodents, and others are found in *Simimys vetus*, *S. simplex*, and ?*S. murinus*, late Eocene rodents, of uncertain familial reference (to Zapodidae by Stehlin and Schaub, 1951, and Wood, 1955; tentatively to Cricetidae by Wilson, 1949b: 123-124), that are probably early myomorphs. Resemblance of CM 9951 to upper molars of *Sciuravus* is seen in the quadrate shape with four well developed cusps, cresting of protocone and hypocone, and a shelf-like anterior cingulum. However, in no species of *Sciuravus* are the anteroexternally directed crests from protocone and hypocone so obliquely oriented as in CM 9951, not even in *S. powayensis*, a late Eocene species having some tendency in this direction (Wilson, 1940: 87-91). Further differences from *Sciuravus* are the presence in CM 9951 of a more elongated crest from the protocone that contacts the anterior cingulum anterobuccally, and a better developed mesoloph. *Simimys* resembles both *Sciuravus* and CM 9951 in having quadrate upper molars, but is more similar to the latter in having obliquely oriented crests. Molars of *Simimys* and ?*S. murinus* are smaller and tend to be relatively more elongated anteroposteriorly than in CM 9951. *Simimys vetus* and ?*S. murinus* resemble CM 9951 in having the crest from the protocone extend to contact the cingulum anterobuccally, whereas in *S. simplex* the crest extends to the anterior side of the paracone. A striking difference from CM 9951 is presence in *Simimys vetus* and *S. simplex* of a strong, posteroexternally directed crest from the protocone, the "mure" of Wilson (1949a: 20-21), which contacts the crest from the hypocone in the transverse valley. Crests and cusps of these species thus produce a W-shaped lingual

pattern. ?*Simimys murinus* and CM 9951 are more similar lingually, the former having only rudimentary development of the "mure." *Simimys simplex* and CM 9951 have in common a longer mesoloph than in *S. vetus* and ?*S. murinus*. Thus, CM 9951 combines a basically similar pattern with details found variously in *S. vetus*, *S. simplex*, and ?*S. murinus*.

Evidence for taxonomic assignment of *Simimys* and ?*S. murinus* is based not only on tooth morphology but also on dental formula and skull structure, especially as shown by ?*S. murinus*. The careful analysis by Wilson (1949a: 18-24) of all evidence available for the species involved led to the interpretation of these rodents as primitive myomorphs that were perhaps not yet differentiated into the muroid and dipodoid levels, were not directly ancestral to later myomorphs, and, further, were derived from sciuravids. For CM 9951 evidence on relationships comes from tooth morphology only, and this is not adequate to indicate the evolutionary level attained by the rodent represented. Dental similarities to sciuravids and to *Simimys* of CM 9951 suggest that this is a late Eocene rodent somewhere in the sciuravid-myomorph menage. Whether sciuravid or primitive myomorph only more adequate specimens will determine.



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## ABNAKI INDIAN ARTIFACTS IN CARNEGIE MUSEUM

JAMES L. SWAUGER

Associate Director

Carnegie Museum

MUS. COMP. ZOO.

MAR 10 1966

HARVARD  
UNIVERSITY.

## INTRODUCTION

Abnaki Indian artifacts in Carnegie Museum are one lot of nine baskets bought in 1900 by Dr. W. J. Holland, at that time Director of the Museum. Holland bought 11 basketry items; only nine can now be found.

The purchase was formally recorded in an Annual Report of Carnegie Museum (Holland, 1901: 37), as: "Holland, Dr. W. J. Collection of baskets, eleven specimens, showing modern work of the Abenaki [sic] Indians of Old Town, Maine. Purchase. July 7, 1900. . . . (1456) [Accession Number]."

Although Holland spelled the term "Abenaki" in his original description of the collection, and all Carnegie Museum records repeat the usage, I here use "Abnaki" since it is a well established, more widely used, and more acceptable form of the designation (Hodge, 1907: 2; Swanton, 1952: 13; Murdock, 1958: 98).

As Holland bought the baskets at Old Town, they were probably made by members of the Penobscot tribe (Federal Writers' Project, 1937:295, 296), but here they will be called only Abnaki, a generic term designating an Algonquian confederacy centering in Maine.

These were commercial items. Although woven in checkerboard fashion, the simplest sort of technique, there is no monotony among them. They are bright, attractive, intended to woo customers. They are dyed in earthy colors: olive brown and olive green, light-yellow ocher, and raw umber. Weft splints vary in width and were woven to produce pleasant textural patterns. Thin ropes of sweet grass were substituted for some warp splints on some baskets to add even greater variety. Rows of projecting ornaments occur, made by twisting a splint into a loop or



Fig. 1



S-NA- P[itsburgh]

loops after pulling it under a warp stick and before passing it under another. Lid handles in the form of ends of corn cobs, loops, flat ropes of grass, and flattened coils of grass ropes add further embellishment. Splints are of ash. The baskets do not deviate from the general description of "Algonkin and Iroquois Basketry," given 15 years before Holland's purchase, in Mason's *Basket-work* . . . (Mason, 1885: 305, 396 pl. lviii, fig. 96) and must be considered good representations of Abnaki basketry at the turn of the century.

#### DESCRIPTIONS

All measurements are given in centimeters. Colors were defined for me by Clifford J. Morrow, Jr., Chief of the Special Exhibits Staff, Carnegie Museum. All items are baskets.

1456/1. Not found when the collection was listed on January 16, 1936. It was noted on a file card as "Basketry napkin ring . . ."

1456/2. (Fig. 2) Spherical, lidded basket. Lid neck fits into neck of basket. Greater diameter of the body is 34. Interior diameter of neck of basket is 16. Diameter of exterior of neck of lid is 15. Greatest diameter of lid is 18. Lid is decorated with a vertical cone shaped like the end of a corn cob. A row of curled splints surrounds the cone at its base. The height of the cone is 5.5. The height of the lid minus the cone is 3. The height of the body of the basket is 25.5. The total height of the basket with lid on and pressed firmly into its seat is 32. The basket is cadmium orange. The cone is olive brown. Eight rows of weft splints on the base are slightly twisted to make an ornamental base projection. There are 21 warp splints, 107 weft splints in the body of the basket. The warp splints average 0.8 wide at the neck, 1.6 at their greatest width, 0.4 where they cross in the center of the base. The weft splints average 0.3 in width. At the neck, the warp splints are gathered and bound to a withe, the binding going over a rope of grass. The rim of the top of the lid is outlined by a rope of grass bound into warp splints. There are 16 warp splints in the lid, and 21 rows of weft splints. On the underside of the lid the warp splints are drawn into a shallow cone. The lid warp splints average 1.2 at the circumference, 0.3 at the center. Weft splints average 0.3 wide. Weft splints of the cone average only 0.1. Greatest width of the cone's warp splints is at their bases, where they average

0.4. The lid flange, which is inserted into the neck of the basket, is 2.4 wide and is bound with splints averaging 1 wide.

1456/3. (Fig. 2, two views) Strawberry- or pine-cone-shaped, lidded basket. Lid fits over basket neck. Greatest diameter of the body, including projections of loops of weft splints is 37.25. Diameter of body of basket at neck, exclusive of projections of loops of weft splints, is 21. Diameter of interior of neck of lid is 22.5. Height of basket without lid is 26.5. Height of lid excluding handle and petal decorations is 6. Height of basket and lid with lid pressed firmly into its seat, and excluding handle and petal decoration is 28.5. The lid is attached to the body by a coil of splint. Opposite the coil is a ring bound to the lid in position to slip over a complementary ring, bound to the body of the basket, to hold the lid firmly on the basket. A rope of grass 22 long ends in a closed loop to make a handle projecting from the lid. The handle rises from a rosette of cut grasses and a circle of 16 dark-brown, leaf-shaped, thin "petals." The body of the basket is a light Alizarin crimson. Ornamentation of the body and the lid is provided by rows of loops of weft splints, 42 on the body, 15 on the lid. There are 20 warp splints, 57 rows of weft splints in the body. There are 20 warp splints in the lid, 31 rows of weft splints. Warp splints of the body are bound at the base to a ring of wood 3.2 in diameter, its center hole 1.5 in diameter. At the rim, the warp splints are bound to a withe. Warp splints of the lid are drawn into a shallow cone on the underside. At the rim of the lid, they are bound to a withe so flexible it might almost be a weft splint. Sixteen rows of light-yellow-ocher splints decorate the underside as well. Warp splints average 1 at the rim of the body, 1.4, ten away from the rim of the body. Weft splints average 0.5. Warp splints of the lid average 1.4 at the rim, 0.3 at the center. Most weft splints average 0.5 wide, but the light-yellow-ocher splints making up the inside decoration average only 0.2.

1456/4. Not found when the collection was described December 21, 1962. It was noted on a file card as "Truncated pyramid, light yellow, 7-1/2" square at base, 12-7/16" high, and 9-1/2" diam. at top . . ."

1456/5. (Fig. 2) Oval, wide-mouthed basket. One splint loop on long diameter. The longest diameter is 11.5. The shortest is 7.5. Depth of body of the basket is 3.5. Distance from bottom of the basket to the top of the handle loop is 8. The splint making up the handle loop continues in a broad oval as a rib along the base. The warp splints are

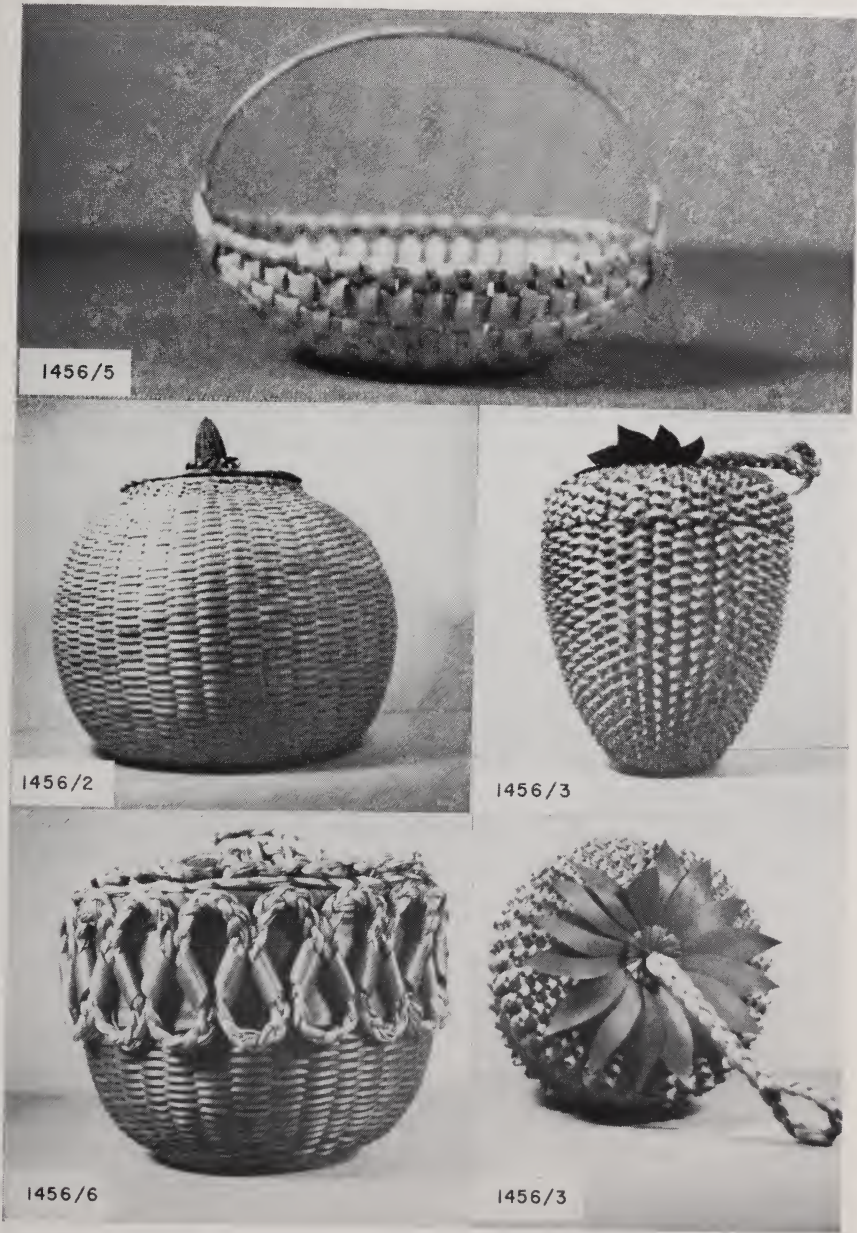


Fig. 2



horizontal, paralleling the line of the handle and base-rib loop. There are eight warp splints. Width of the warp splints in their centers is 0.9. They taper to nearly zero at the ends. There are 33 weft splints, gathered at the ends of the basket into diamond designs where the handle loop crosses the rim with the. This with the is bound into the body of the basket by the weft splints which loop over it. The basket is light-yellow-ocher.

1456/6. (Fig. 2) Round, lidded basket. Lid is loose. Lid neck fits into neck of basket. Greatest diameter of the body of the basket is 17.5. Diameter of the body at the neck is 15. Height of the body to the top of the with the binding the rim is 11.5. Height with lid on, including decoration but excluding loop handle, is 13. The body of the basket is olive brown. Decorations of lid and body include ropes of grass which are raw umber in color. Other decoration is provided by varying widths of splints. There are eighteen warp splints and 41 rows of weft splints to the rim-binding on the body of the basket. Thirty-six of the rows of weft splints average 0.1 wide. The succeeding two rows, as one moves toward the rim from the base, average 2 wide. Three rows are caught under the rim binding. There is a base ring made of a rope of grass. The warp splints are drawn into a cone on the inside of the base. On the exterior rim of the body a rope of grass is drawn into a series of 37 vertical loops measuring 6 high. These are bound into the body by the two, 2-wide weft splints noted above. The rim of the basket is bound into a sturdy with the. Loop decorations like those on the exterior rim of the body decorate the lid. There are 17 of these. They, too, are bound to their support by two weft splints larger than those of the rest of the lid. These large splints (there are two of them) average 1.8 wide. Only 12 small splints are visible. They are 0.2 wide. The 17 warp splints are drawn into a cone on the underside of the lid. These are a bit over 0.2 wide. The rim is bound with a rope of grass, and a loop of grass is a handle at the top. The neck of the lid is 1.5 deep.

1456/7. (Fig. 3) Squat, cone-shaped basket. Lidded. Lid fits over basket neck. Greatest diameter of the body of the basket is 8. Height of body minus lid is 9. Hoop on lid is bound to the body by a splint tie. Opposite its attachment, a loop on the basket corresponds to a loop on the lid which slips over it to lock it in place. There are 12 warp splints. Their widths vary from 0.2 where they cross at the base to 0.9 at the neck. The neck is bound by a flat with the. There are 65 weft splints. These

average 0.2 wide for the most part, but that nearest the neck with is 0.4. The color of the body is olive green. The lid is made up of a rope of grass for a base, a body of 24 warp splints, and 28 ropes of grass serving as weft splints, as well as five conventional weft splints. The warp splints are bound in the interior to a circle of wood. Here they average 0.2 wide. At their distal ends, they average 1.2. Two loops, set opposite each other across the center circle at points where the grass-loop weft splints meet the conventional type, project upward 2. Through them runs a splint loop 10.5 in diameter, bound with a grass rope. The lid is 3.5 from its base to its top, excluding the loops, and has a maximum outside diameter of 10.5. The body of the basket is olive green. Exclusive of the weft splints, which also are olive green, the lid is raw umber.

1456/8. (Fig. 3) Lidded basket. Neck of lid fits into basket. Decorated at neck and base with a row of projecting ornaments formed by twisting weft splints. Diameter of outside of neck of body excluding projections is 18.2. Diameter of the base ring, exclusive of projecting ornaments, is 10. The rim of the body is a rope of grass bound to the body. The base ring is a vertical splint from which the ornaments project. There are 20 warp splints, forming a cone in the bottom of the basket. At the center of the bottom they average 0.4, at the rim, 1. There are 47 rows of weft splints. They average 0.2, except for the next-to-the-top one, 1.3 wide, which forms the projecting ornamentations. The lid has a diameter of 18.5. Its rim is bound with a rope of grass. Its neck is 1.4 deep. It has 19 warp splints which form a downward projecting cone in the center of the underside of the rim. At the center, they average 0.2; at the rim, 1.0. There is a loop handle of a rope of grass, raw umber in color, projecting 5 from the top of the lid. The ends of the rope have been left frayed to add to the decorative effect. Without counting the handle, the lid is 2 high. The warp splints are alizarin crimson, and the weft splints olive brown.

1456/9. (Fig. 3) Round basket. Lidded. Lid fits over body of basket. Smooth, more "western" looking than the rest of the baskets in the collection. The body is 17 in diameter. There are 22 warp splints averaging 0.9 wide. From the base upward there are, first, eight rows of conventional weft splints averaging 0.1 wide, then rows of grass forming a band 4.5 wide, then a splint 1.3 wide just below the rim, which is itself a splint bound to a stout with on the interior. The rim of the base is a rope



of grass. On the bottom are 10 rows of weft splints varying in width from 0.1 to 0.2, then a clear space of 1.7, then nine rows of weft splints averaging 0.1 in width. The warp splints cross on the interior of the base to form a smooth, upward-projecting cone. The body is 8 high. The lid is 18.5 in greatest diameter, including the rope of grass which is the circumference binding. The interior of the neck is 17.8 in diameter. The neck is 2 high. The vertical section of the neck has a base splint 0.4 wide, succeeded by 12 rows of conventional splints 0.1 wide to the rim of the top of the lid, then four rows of conventional splints 0.1 wide. For a distance of 4 toward the center—then a gap of 0.7 occupied by eight rows of conventional splints 0.1 wide—then a section 2.4 wide, there are rows of grasses giving a pleasing decorative effect. From the center of the top of the lid projects a flat loop 3 in diameter bound by a splint into the center of the lid. The color of the basket is light-yellow-ocher.

1456/10. (Fig. 3) Square, lidded basket. Lid fits over neck of basket, not down over, just over. The body is 22 on an edge. Weaving is a simple checkerboard. On the bottom of the body there are 14 splints 1.4 wide forming the main section of the body in both directions. At the corners these wide splints give way to 16 to 18 rows of splints only 0.2 wide on an average, and these in turn alternate with eight to nine rows of grass ropes. The top of the body shows four triangular areas, one on each side, apexes toward the center, and between these and the corners are four triangular areas made up of 36 to 38 rows of narrow splints alternating with 18 to 19 rows of grass ropes. The grass ropes are raw umber, the conventional splints, olive brown. The square hole in the center (not parallel with the sides) is 10.4 on a side on the interior, and bound with a grass rope. A loop is bound to the body along one side of the hole in the center. On the opposite side of the hole two splints bind the square lid to the body. The lid is also bound with a grass rope and has a loop 2.7 in diameter which slips over the loop on the body. The lid has eight warp splints 1.2 wide, exclusive of the edge binding, 37 rows of weft splints averaging 0.2 wide, and 17 rows of grass ropes. The lid is 12 on an edge. Without the lid, the height of the body is 4; with the lid, it is 4.8.

1456/11. (Fig. 3) Pine-cone-shaped basket. Lidded. Lid fits over neck of basket. Decoration is furnished by rows of projecting loops over both body and neck. There are eight warp splints 0.5 wide at the neck,

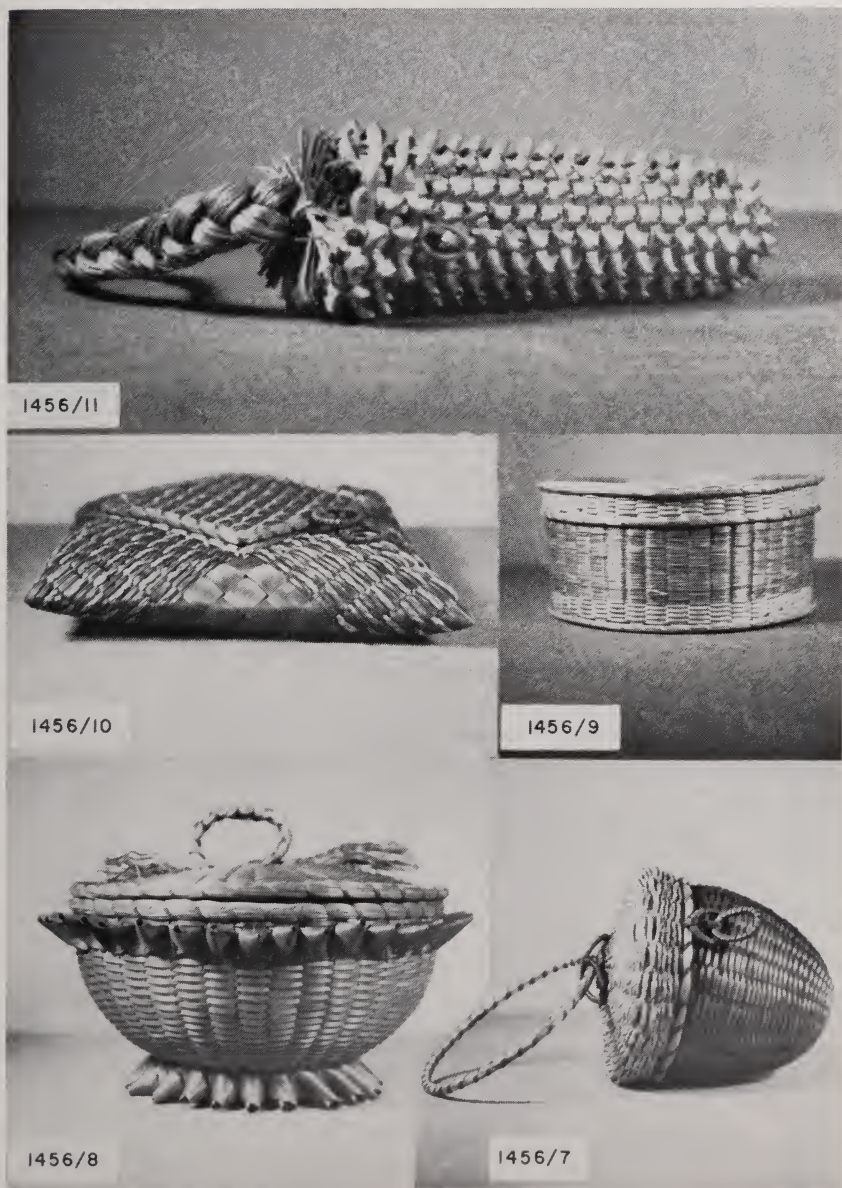


Fig. 3

tapering to 0.1 or slightly less where they cross at the base. There are 37 rows of weft splints, including the top splint which forms the rim and around which the warp splints are bent. Of these rows of weft splints, 32 are drawn out and looped into the projecting ornaments. The splints average 0.4 over the body of the basket, 0.2 at the base. The body is 16 high and 4.9 in diameter at the neck, which is a good measure of the greatest diameter of the body exclusive of the loops. The lid is 3 high exclusive of the 14-long grass-rope loop handle. The lid has a loop projection which slips over a weft splint loop to secure the lid to the body. It is likely that at one time the lid was bound to the body opposite the catch loop, but if so, the splint that bound it is now gone. The lid has eight warp splints averaging 0.5 at the rim, tapering almost to nothing in the center. There are 11 rows of weft splints, of which eight form projections. They average 0.4 in width. The basket is light-yellow-ocher in color.

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S-NA-P [its bough]

PAUSSID BEETLES IN THE CARNEGIE MUSEUM COMP. ZOOL.  
(COLEOPTERA, CARABIDAE) LIBRARY

12th Contribution to a Monographic Study of the Paussinae

APR 20 1966

Eduardo Luna de Carvalho  
Museu do Dundo, Angola, Africa

HARVARD  
UNIVERSITY.

I am grateful to Dr. George E. Wallace, Curator of Insects and Spiders at Carnegie Museum, for the opportunity to study the Paussinae in that collection, and to Mrs. Jean W. Fox for assistance in making arrangements and in reading manuscript. I also would like to thank my friend, M. P. Basilewsky, Curator of the Entomological Section of the Musée Royal de l'Afrique Centrale, Tervuren, Belgium, for lending several holotypic specimens of *Marshallipaussus* and thus enabling direct comparison with the new species described below. (The abbreviation CM stands for Carnegie Museum.)

Family Carabidae  
Subfamily Paussinae  
Tribe Protopaussini  
Subtribe Cerapterina  
Genus *Arthropterus* Macleay  
*macleayi* group

*Arthropterus wasmanni* Kolbe

## Figure 1

AUSTRALIA: Queensland (collection Klages; CM Accession 2275), one specimen, labeled "*Arthropterus ustus* Dhn.", an unpublished name.

Kolbe (1924, Tijdschr. Ent., The Hague, 67) described this species from Peak Downs, Queensland, but Reichensperger had previously used *Arthropterus wasmanni* for a species from Abyssinia (1915, Ent. Mitt., Berlin, 4: 120, 122). Wasmann (1926, Zool. Anz. Leipzig, 68: 232) proposed to substitute *queenslandiae* as the name for the Kolbe species in order to avoid homonymy, but since Reichensperger's species has been transferred to the genus *Mesarthropterus* it seems best to retain *Arthropterus wasmanni* Kolbe.

Submitted for publication June 19, 1964  
Issued April 8, 1966

DESCRIPTION: A little larger than the Kolbe holotype, the Carnegie Museum specimen measures as follows: body length 13.5 mm., width 4.7 mm.; length of antennal club 5.5 mm., width 1.7 mm.; length of prothorax 2.4 mm., width 3.2 mm.; length of elytra, 9 mm., width 4.7 mm.

Genus *Cerapterus* Swederus  
Subgenus *Cerapterus*, *sensu stricto*

*Cerapterus denoiti denoiti* Wasmann

CAMEROON: Lolodorf, 3° 17' N., 10° 50' E.; Efulen, 2° 51' N., 10° 35' E.  
GABON: Kangué (on Ogooué River). 30 specimens.

This is the commonest *Cerapterus* in the region.

Subgenus *Euthysoma* Thompson

*Cerapterus concolor concolor* Westwood

NATAL: Durban, 29° 53' S., 31° 00' E. (from collection Holland), 1 ♀

Records from the Congo-Cameroons region include two varieties, *concolor* and *virgula* Thompson.

Genus *Homopterus* Westwood  
Subgenus *Homopterus*, *sensu stricto*  
*brasiliensis* group

*Homopterus brasiliensis* Westwood

BRAZIL: Rio de Janeiro, 22° 56' S., 43° 12' W., Dec., 4 specimens.

This species, described in 1841 from Monte do Carcovado, Rio de Janeiro, was the first found in the New World and now is known from various localities in Brazil, Paraguay and Argentina.

Genus *Carabidomemnus* Kolbe  
Subgenus *Carabidodoxus* Kolbe

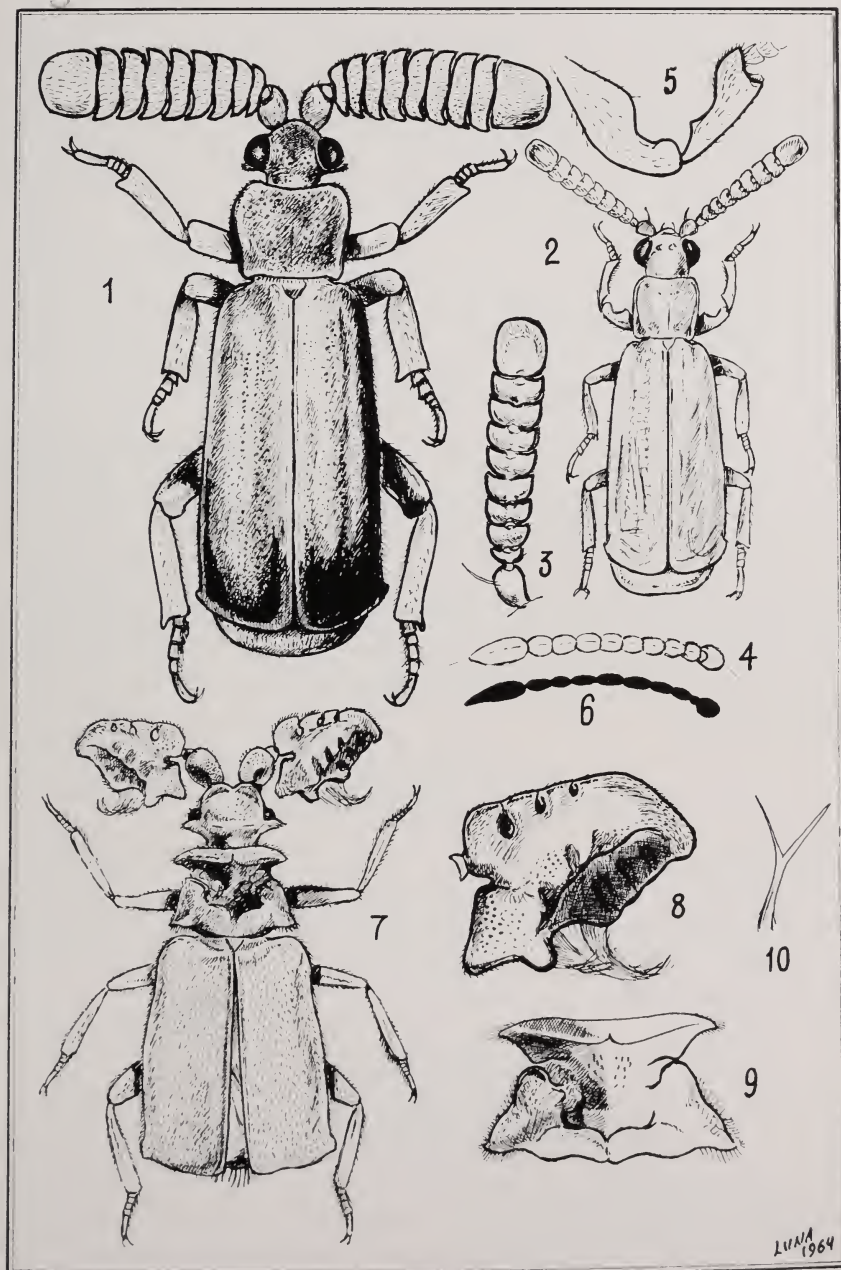
*Carabidomemnus jeanfoxae*, new species Figures 2, 3, 4, 5

CAMEROON: Lolodorf, May, 1923 (A.I. Good), holotype, 1 ♂?

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Fig. 1, *Arthropterus wasmanni* Kolbe, dorsal view. Figs. 2 - 5, *Carabidomemnus jeanfoxae*, new species; fig. 2, dorsal view of holotype; fig. 3, right antenna in dorsal view; fig. 4, right antenna in lateral view; fig. 5, femur and coxa of foreleg. Fig. 6, lateral view of right antenna of *Carabidomemnus evansi* Reichensperger. Figs. 7 - 10, *Paussus ypsilipilos*, new species; fig. 7, dorsal view of holotype; fig. 8, right antennal clava; fig. 9, dorsal view of prothorax; fig. 10, elytral clothing seta, highly magnified.

S-NA-P



DESCRIPTION: Body length 5mm., width 2.0 mm. Antennal club 1.5 mm. long, width at the middle 0.25 mm.; chestnut red, shining, glabrous. Head subquadrate, flat, with two anterior bristles; eyes prominent, blackish; neck the same width as the head between the eyes. Antennae with first segment spherical and with a single apical bristle (a peculiarity of some Carabidae); antennal club (fig. 3, 4) four and one-half times longer than wide; first segment narrower and shorter than the second; second to fourth segments gradually enlarged; fifth to eighth similar and twice as wide as long; apical segment rectangular and equal to the combined length of the seventh and eighth segments. Prothorax quadrate a little wider at the base than at the apex, the sides emarginate, not fringed with hairs; a short, narrow, median longitudinal groove present. Elytra a little less than twice as long as wide (3.5 mm. x 2.0 mm.), very finely but sparsely punctured and glabrous; sides with no more than ten hairs. Legs with tibiae moderately broad and slightly compressed, the fore tibiae arcuated inward (fig. 5) and with a small smooth tooth at the base; anterior femora slightly arcuate and obtusely angulated; tarsi cylindrical and half as long as the tibiae; pygidium glabrous, rounded and not punctured.

This new species is similar to *Carabidomemnus evansi* Reichensperger (fig. 6) but is smaller and has a more robust antennal club (fig. 4), which has spherical joints when seen in lateral view. It is dedicated to Mrs. Jean W. Fox, Entomologist in the Section of Insects and Spiders, Carnegie Museum.

Tribe Heteropausini  
Genus *Heteropausus* Thompson

*Heteropausus dohrni* (Ritsema)

GABON: Kangué (on Ogooué River), (A.C. Good), 7 specimens.

Described originally from the Congo, this *Heteropausus* is relatively common in West and Central Africa.

Tribe Paussini  
Subtribe Paussina  
Genus *Paussus* Linné  
*cucullatus-boysi-aureofimbratus* group

*Paussus braunii* Peringuey

SOUTHERN RHODESIA: Bulawayo, 20° 10' S., 28° 43' E., Apr. and May, 1924 (R.H.R. Stevenson), 3 specimens.

An additional specimen of this rare species, from the same locality, is in the author's private collection.

*Paussus cucullatus* Westwood

SOUTHERN RHODESIA: Bulawayo (Stevenson), 5 specimens.

This species appears to be common throughout West, Central, and East Africa.

*bicornis* group

*Paussus kohli* Wasmann

CAMEROON: Lolodorf, Sept., 1913, 1 specimen.

This is the first record from Cameroons of this rare species. Only three other specimens are known, and all were collected in the Congo.

*curtisi* group

*Paussus curtisi* Westwood

SOUTHERN RHODESIA: Bulawayo, Apr., 1924 (Stevenson), 2 specimens.

*cephalotes-bohemani* group

*Paussus fallax* Perringuey

SOUTHERN RHODESIA: Bulawayo, 1 specimen. NYASALAND: Cholo, 16° 03' S., 35° 08' E., 1 specimen. Both Sept., 1918.

*cultratus* group

*Paussus cultratus* Westwood

SOUTHERN RHODESIA: Bulawayo, 2 specimens.

*spinicoxis* group

*Paussus spinicoxis* Westwood

SOUTHERN RHODESIA: Bulawayo; Selinde Mountains, 20° 24' S., 32° 43' E., 4500 ft., Dec., 1929 (R. and C. Boulton). 4 specimens.

Subgenus *Marshallipaussus* Kolbe

*Paussus ypsilopilos*, new species

Figures 7, 8, 9, 10

CAMEROON: Yaounde, 3° 51' N., 11° 31' E., Mar. 28, 1923, holotype.

DESCRIPTION: Body 5.5 mm. long, 2.5 mm. wide; antennal club 1.7 mm. long, 1.4 mm. wide. Elytra reddish brown, shining, testaceous and densely pubescent with Y-shaped setae (fig. 10). Head slightly rugose with two small rudimentary glandular openings and two short striae at the transverse ridge near the neck; eyes with bristles; postocular angles acute with bristles at the apex. Antennae with quadrate first segment; the cla-



vae large and shell-like (fig. 8), the acute front margin with three deep, transverse depressions and the basal edge deeply incised, the posterior-basal angle somewhat acute and large, three shallow, transverse depressions in the outer, and three on the inner edge of the excavation, the margins of the excavation relatively rectilinear. Prothorax (fig. 9) as wide as the head, the anterior portion shorter with a sharp transverse ridge produced to an acute angle at each end; the center portion deeply excavated with a tuft of golden setae on each side; the posterior portion—slightly more glabrous than in *P. spiniceps* Wasmann—at each side dilated outward in the form of a triangular spine; the trichome composed only of a row of setae, not of the tuft of golden setae typical of species in subgenus *Marshallipaussus*. Elytra oblong (3.5 mm. x 2.5 mm.) with a dense over-all clothing of small apically bifurcated setae (fig. 10). Legs slender, with tibiae compressed and but very slightly dilated and lacking apical spurs; tarsi cylindrical and about two-thirds the length of the tibiae; pygidium densely punctuated and provided with large marginal setae.

This species is similar to *P. spiniceps* Wasmann, but the dense Y-shaped clothing setae on the elytra and the very rudimentary trichomes at the posterior angles of the prothorax are sufficient to distinguish it.

*Paussus spiniceps* Wasmann

CAMEROON: Yaounde, Mar. 20, 1928, 1 ♂, 1 ♀



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REPORTS ON THE MARGARET M. CARY-CARNEGIE MUSEUM  
EXPEDITION TO BAJA CALIFORNIA, MEXICO, 1961.

4. The Family Saturniidae (Lepidoptera)

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FREDERICK H. RINDGE

Curator, Department of Entomology  
The American Museum of Natural History.

APR 20 1966

HARVARD  
UNIVERSITY

*This is the fifth paper based on the Margaret M. Cary-Carnegie Museum Expedition to Baja California, Mexico, 1961, and the fourth to appear in the Annals of Carnegie Museum. For an account of the itinerary and description of localities see the first paper in this series (Richard M. Fox, 1963, Ann. Carnegie Mus., 36 (16): 181-192). Except as noted, all specimens including type series are in the collection of Carnegie Museum.*

The members of the expedition caught representatives of seven species of Saturniidae. Four of these were taken in Sinaloa, and the other three in Baja California Sur. Of the latter, one species represents an endemic taxon, heretofore apparently known only from the unique type and a single female in the collection of the American Museum of Natural History. The second species is represented by an endemic subspecies, described in this paper, of a widely ranging taxon in the southwestern United States and Mexico. The third species is one that occurs across Mexico and extends north into Arizona; this is the first Baja California record for this moth.

Relatively few members of the Saturniidae have been recorded from Baja California. Hoffmann (1942) lists most of these, although he omitted two species cited by Bouvier (1932, 1936). The total number of species given in these articles is eight; one additional taxon is added in the present paper. Two endemic species, *Syssphinx digueti* (Bouvier) and *Hemileuca sororius* (Henry Edwards), are present on the peninsula. Two endemic subspecies have been named, one for *Saturnia*

*galbina*, in this paper, and *Hyalophora euryalus cedrosensis* (Cockerell), described from Cedros Island. Three additional members of the genus *Hemileuca* have been reported: *electra* Wright, which occurs in southern California and Sonora (Hoffmann, 1942); *nevadensis* Stretch (*californica* Wright), a species of the Great Basin area that reaches southern California; and *lex* (Druce), a taxon from central Mexico which Bouvier (1932: 410) reports as occurring in "Basse-Californie." The remaining two species are both large-sized members of the Saturniinae: *Hyalophora calleta* (Westwood), reported from Baja California for the first time in this paper, and *Rothschildia jorulla cincta* (Tepper), described from Arizona.

Much more collecting of this family is needed in Baja California. Several of the above references need checking when adequate material comes to hand. It is very possible that a number of species of Saturniidae occur in Baja California that have never been reported or described.

The generic terminology used in this paper is that of Michener (1952).

#### Subfamily CITHERONIINAE

**Syssphinx (Bouvierina) heiligbrodti heiligbrodti (Harvey)**

*Anisota heiligbrodti* Harvey, 1877:110.

The single specimen agrees well with three other males from Culiacán, Sinaloa. The nominate subspecies is also found in Tamaulipas and Coahuila, as well as in Texas.

SINALOA: 46 miles north of Los Mochis, Oct. 22, 1 ♂.

**Syssphinx (Bouvierina) digueti (Bouvier)**

*Adelocephala digueti* Bouvier, 1929:249, pl. 3, fig. 10.

This species was described from "Basse-Californie," without any further data, and was based on a single female specimen. The males are similar to the females, but smaller in size. In wing length the males range from 26 to 33 mm.; the females from 34 to 40 mm. In addition to the records given below, there is a single female in the collection of the American Museum of Natural History from San Felipe, Baja California Norte, Oct. 5, 1953 (Ryckman, Lee, and Ames). Apparently this species is endemic to Baja California.



BAJA CALIFORNIA SUR: Bahía de Palmas, Oct. 7, 1 ♂; San José del Cabo, Oct. 25, 1 ♂; La Paz: Guaycura Hotel grounds, Oct. 28, 1 ♂; Rancho Palmerito, Oct. 30, 1 ♂, Nov. 24, 1 ♂; Arroyo San Bernardo (Sierra Laguna), Nov. 13, 1 ♀, Nov. 17, 1 ♂; Boca de la Sierra, Nov. 17, 1 ♂, 1 ♀. (3 ♂, 1 ♀ AMNH).

*Adeloneivaia pacifica* (Schaus)

*Adelocephala pacifica* Schaus, 1911:627.

Three males were taken in Sinaloa that may be referable to this species. A dissection of the genitalia (F.H.R. no. 12,235) and a comparison with the male structures of *pacifica* and *irrorata* Schaus was not too helpful, as there did not appear to be many differences between the genitalia of these two taxa.

SINALOA: Concordia, Oct. 21, 1 ♂; 16 miles north of Mazatlán, Oct. 28, 2 ♂. (1 ♂ AMNH).

Subfamily HEMILEUCINAE

*Automeris (Automeris) io mexicana* Draudt

*Automeris io mexicana* Draudt, 1929:744, pl. 111Af.

Hoffmann (1942:239) gives the distribution of this subspecies as being from the valley of the Río Balsas, Guerrero, and the Pacific coast states as far as Sinaloa. The members of the expedition caught a series of seven specimens in Sinaloa, and they agree very well with other examples from that state and Guerrero.

SINALOA: 5 miles west of Concordia, Nov. 2, 6 ♂, 1 ♀. (3 ♂ AMNH).

Subfamily SATURNIINAE

*Saturnia (Agapema) galbina pelora*, new subspecies

This subspecies is the largest and among the palest of the several named populations of *galbina*.

MALE: Upper surface of forewings dark gray or grayish black; pattern as in nominate *galbina*, with broad white t. a., t. p., and subterminal bands; t. a. and t. p. lines 1 to 2 mm. in width; inner side of s. t. line 3 to 4 mm. from wing margin, with small outward teeth on veins in upper part of wing only, and with terminal area light gray; apex of forewing with prominent reddish black dash, with red scaling recurving on costa. Hind wings white with broad, dark gray, extra discal band, and with faint trace of median line only; subterminal band white, broad, 2 to 3 mm.

from wing margin, with very small outward teeth on veins; terminal areas as on forewings; eye spots on all wings similar to those of nominate subspecies.

**UNDER-SURFACE OF WINGS:** Similar to those of nominate *galbina* but paler, with more extensive areas of white and pale gray; maculation like that of upper surface but with gray areas reduced.

**LENGTH OF FOREWING:** 32 to 36 mm.; holotype, 35 mm.

**FEMALE:** Unknown.

**TYPES:** Holotype, male, Mexico: Baja California Sur: Puerto Chileno, November 25, 1961. Paratypes, both from Baja California Sur: Rancho Palmarito, December 3, 1961 (ultraviolet light), 1 ♂; La Paz: Guaycura Hotel grounds, December 4, 1961, 1 ♂. The holotype is in the collection of the Carnegie Museum; paratypes are in the collections of that institution and of the American Museum of Natural History.

**REMARKS:** The three specimens of the type series are the largest in size of any male *galbina* examined by the author. Male specimens of this species had the following measurements of wing length:

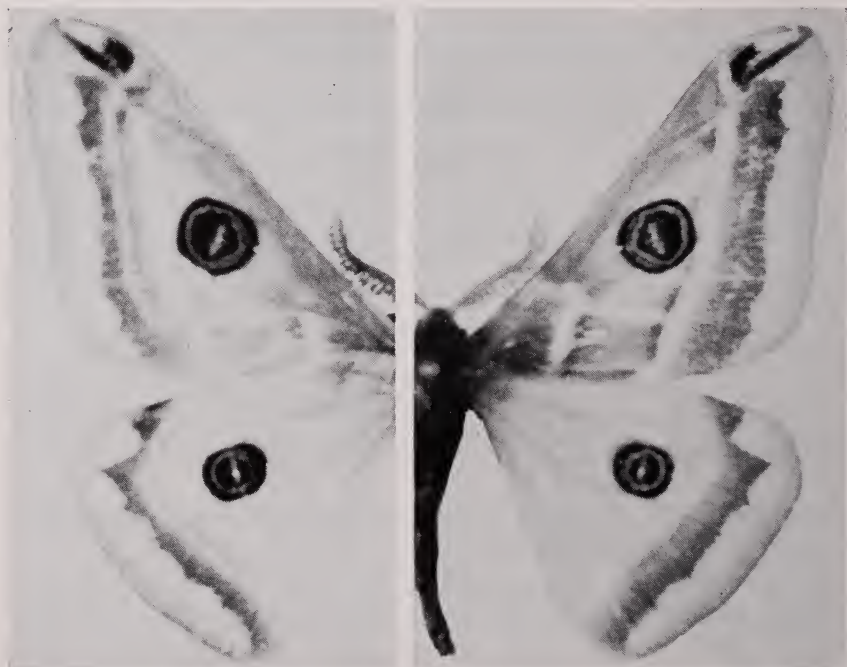


Fig. 1. *Saturnia (Agapema) galbina pelora*, new subspecies. Holotype ♂, Puerto Chileno, Baja California Sur, Mexico, November 25, 1961. Upper side at right, under side at left.

LOCALITY	NUMBER	RANGE	AVERAGE
South Texas	23	25-30 mm.	28.1 mm.
West Texas	13	25-30	27.7
New Mexico	5	24-29	27.0
Arizona	20	25-30	28.0
Durango	14	25-31	28.4
Baja California	3	32-36	34.3

In addition to the large size, this population is one of the lightest in color of this species. This, in part, is because of the extensive white areas and the broad cross lines of the forewing, and also because the dark color of the wings is a gray or grayish black. Most of the populations have this color more or less suffused with dark brown or blackish brown, and this gives a different tint to the wings.

The genitalia were not dissected. Enough could be seen of the outer margin of the valves to verify the presence of the protuberance that is present in *galbina* but absent in *homogena* Dyar.

Bouvier (1936:171) cites *galbina* as occurring in "Basse-Californie," but does not discuss the matter further. It is not known what material he had for this record.

### ***Hyalophora* (*Eupackardia*) *callela callela* (Westwood)**

*Saturnia callela* Westwood, 1853:161, pl. 33, fig. 2.

The nominate subspecies, with the wide white band on the upper surface of the wings, is found in central and southern Mexico between the elevations of 3000 and 6000 feet (Hoffmann, 1942:235). The single female taken on this trip is the first Baja California record; the specimen was taken at a much lower altitude than those given by Hoffmann.

BAJA CALIFORNIA SUR: Rancho Palmarito, Nov. 4, 1 ♀.

### ***Rothschildia jorulla jorulla* (Westwood)**

*Saturnia jorulla* Westwood, 1853:159, pl. 32, fig. 1.

This species has a widespread distribution in Mexico.

SINALOA: 18 miles north of Mazatlán, Oct. 29, 1 ♀.

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THE BONE BRECCIA OF BOOTLEGGER SINK,  
YORK COUNTY, PA.

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INTRODUCTION

Bootlegger Sink has been known for many years. It is described by Stone (1953).

Preliminary collection of breccia from Bootlegger Sink by one of us (Hamilton) in October, 1963, produced the remains of two rodents, the thirteen-lined ground squirrel (*Citellus tridecemlineatus*) and the northern bog lemming (*Synaptomys borealis*), both now extinct in the area. Both species were present in the Late Pleistocene New Paris No. 4 local fauna of Bedford County, Pennsylvania (Guilday, Martin and McCrady, 1964).

A second field trip was made in November, 1963. The results of the two trips are discussed in this paper.

We wish to thank Mr. Jerry Frederick, Miss Monica Rectenwald, and Mrs. Rita Hamilton for able assistance in the field; Dr. T. J. Weisman, Gulf Research and Development Co. laboratories, Harnmarville, Pa. (carbon<sup>14</sup> dating); Mr. Joseph R. Ryan, Harbison Walker Refractories (spectrochemical analysis); Dr. Paul S. Martin, Geochronology Laboratories, University of Arizona [pollen analysis of samples of loam that had been trapped in the breccia (results were negative)]; Mr. Neil D. Richmond, Curator of Amphibians and Reptiles, Carnegie Museum (amphibians and reptiles); Dr. Nell B. Causey, University of Arkansas (millipedes); Dr. J. Kenneth Doult, Curator, and Miss Caroline A. Heppenstall, Assistant Curator, Section of Mammals, Carnegie Museum (caribou). Fig. 1 is by Miss Monica Rectenwald; figs. 2 and 4 by Donald P. Tanner, and fig. 3 by Richard W. Lang. Research was conducted under National Science Foundation grant no. 20868. The initials CM identify Carnegie Museum catalogue numbers.

Submitted for publication April 24, 1964  
Issued April 8, 1966

Bootlegger Sink, latitude  $40^{\circ} 01' 00''$  N., longitude  $76^{\circ} 43' 30''$  W., altitude 350 feet, is one-quarter mile east of Emigsville, Manchester Township, York County, southeastern Pennsylvania. The sink is on a gently sloping hillside approximately one-half mile west and 50 feet higher than Codorus Creek, the master stream of the area. From this point, Codorus Creek flows four miles in a northeasterly direction to join the Susquehanna River some 50 miles west of its mouth at Chesapeake Bay. As Codorus Creek approaches the Susquehanna River it becomes intrenched and meandering. At its mouth near Codorus Furnace it has entrenched for some 200 feet. The general land surface rises gently to the north from Bootlegger Sink to the south bank of the Susquehanna River so that the sink is only 100 feet above the Susquehanna River level.

Physiographically, Bootlegger Sink lies within the Limestone Valley Section of the Piedmont Province. This broad, fertile, intensely farmed valley some ten miles wide lies between the Piedmont Highlands to the east and the Triassic Lowlands to the west, north of the Pigeon Hills.

York County is over 80 per cent cleared land, most of it in cultivation for three hundred years. Soils range in color from brown through orange to reddish. They are composed principally of residue from limestone removed by solution. They are classified in the Hagerstown series and are among the most valuable farming soils of the state.

Geologically, the sinkhole is formed in the Vintage dolomite of lower Cambrian age. It lies just east of the Triassic Lowlands belt in a region of contorted and faulted limestones and quartzites.

The climate is temperate. Observations at Hanover, York County, 20 miles southwest of the sink in the same physiographic province indicate a frost-free period of 173 days, mean January temperature  $33.1^{\circ}\text{F.}$ , mean July temperature  $75.8^{\circ}\text{F.}$ , with an average annual precipitation of 40.07 inches.

In its primitive condition, the area was covered with an oak forest, probably dominated by white oak (*Quercus alba*), but the original forest cover was removed so long ago that its exact make-up is in doubt. This portion of the state is well within the Carolinian life zone, sharing closer affinities with the biota of the Coastal Plain than with the mountainous areas of the State.

The breccia occurred as a ledge 1.2 meters above the present active talus (fig. 1). Varying from 0.13 meter to 1.2 meters thick, it projected 0.15 meter to 3.0 meters from the sinkhole walls. It represents the remnant of a surface-derived talus that once filled the sink to that point. This

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BONE BRECCIA OF BOOTLEGGER SINK

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Fig. 1 Interior of Bootlegger Sink, York County, Pennsylvania. Entrance directly above climbers. Note breccia ledge. Dotted lines indicate areas sampled by Carnegie Museum field parties in 1963. After photo by Mohr, *in* Stone, 1953.



talus may have formed rather abruptly (although the faunal assemblage appears to be a mixed one), or at least at a faster rate than it could be removed by the stream now flowing across the floor of Bootlegger Sink. Or, possibly, a talus formed on some projecting ledge which eventually was overloaded and collapsed into the bottom of the sinkhole carrying with it all of the talus except that which was cemented to the sinkhole wall.

The bone breccia was composed of a matrix of angular, irregular blocks of unweathered dolomite (80 per cent) derived from the sinkhole walls, of rounded, well-weathered limonitic sandstone pebbles (about 10 per cent, averaging 10-13 cm. in diameter), and another 10 per cent of brown, sandy, unconsolidated loam, all bound together with travertine, 10 cm. thick in many spots. Intermingled with the rock components, in the loam inclusions as well as imbedded in travertine, were lumps of wood charcoal up to 25 mm. square. An occasional fragment of quartzite and weathered argalite also was present. Intermingled in both the unconsolidated loam and in the travertine itself were animal bones, terrestrial snail shells, and a few calcified millipedes. The breccia ledge was covered with a thin coating of weathered, light-gray flowstone, but a freshly broken surface was colorful. The sandstone varied from a bright, sandy yellow to a bright, brick-red which contrasted with the blue-black of the dolomite and the glaring white of the numerous *Triodopsis* shells. The travertine was light tan in color.

The entire breccia deposit is about 8 square meters. Approximately 1.5 square meters were removed by wedging and dynamiting. These were reduced by hammer and chisel, separating the breccia along contacts between the travertine and the inclusions. Charcoal for dating was collected from freshly broken surfaces. Loam inclusions were collected for pollen analysis. When bone was exposed, the final cleaning was done with fine chisels and grinding and vibrating tools. Fortunately, many of the loam inclusions were fossiliferous, and were washed to recover such minute items as insectivore teeth.

#### FLUORINE ANALYSIS OF MATERIAL

In order to test the fauna for contemporaneity 19 samples of bones and teeth representing 17 vertebrate species were submitted to Joseph R. Ryan of Garber Research Center, Harbison Walker Refractories Company, for spectrochemical analysis. (All samples were prepared from items broken out of breccia blocks. All were intimately associated.) The



assumption was made that percentage of fluorine was positively correlated with age. Results are presented in fig. 2. The fluorine content of the flowstone was 0.78 per cent. This is lower than that of any of the enclosed bones, but higher than the one snail (*Triodopsis albolabris*) shell tested, 0.30 per cent.

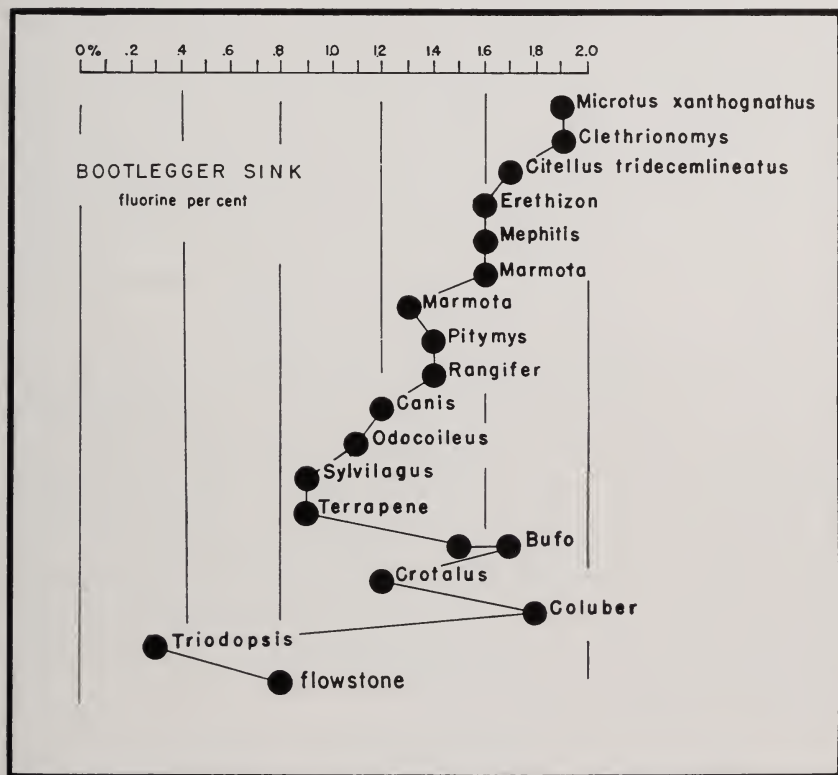


Fig. 2 Fluorine content of samples from Bootlegger Sink breccia. See text for explanation. Note two *Bufo* samples.

There is a wide range of values from rabbit (*Sylvilagus* 0.88 per cent) and box turtle (*Terrapene* 0.91 per cent) up to red-backed vole (*Clethrionomys* 1.93 per cent), and yellow-cheeked vole (*Microtus xanthognathus* 1.87 per cent). The values are evenly distributed, which would imply continuous deposition over a long span of time.

In addition to elapsed time, the percentage of fluorine appears to be

related to bone density or porosity. Bone taken from the mandible of a woodchuck (*Marmota monax*) ran 1.60 per cent, while enamel and dentine from the incisor in the same mandible was only 1.29 per cent. Bone from the mandible of a pine vole (*Pitymys pinetorum*) tested 1.44 per cent, while that from the articular surface of a caribou (*Rangifer*) phalanx tested 1.36 per cent. *Pitymys*, a southern form, and *Rangifer*, a northern form, are ecologically incompatible. *Rangifer* undoubtedly predated *Pitymys* in the deposit, and, all things being equal, its fluorine value should have been significantly higher. That it was not may be related to bone density. A sample of deer (*Odocoileus virginianus*) bone, taken from a phalanx, as in the case of the caribou, tested lower (1.12 per cent *Odocoileus*, 1.36 per cent *Rangifer*). These bone samples were of equal density and the results agree with the modern distribution of these animals. *Rangifer*, being the more boreal of the two, would be expected to be older in Bootlegger Sink, hence higher in fluorine content.

Variations in bone porosity may have affected the values of the reptile and amphibian bone samples as well. Dense bone from the carapace of the box turtle (*Terrapene*) was low (0.91 per cent) while porous toad (*Bufo*) limb bones and vertebrae of rattlesnake (*Crotalus*) and black snake (*Coluber*) were much higher. Binford (1965) tested samples of limb bones and vertebrae of snowshoe hare (*Lepus americanus*) from different levels of New Paris Sinkhole No. 4 and found that they behaved as two populations. The cancellous vertebral bone was consistently higher in radioactive thorium than was the denser limb bone material. Since thorium is acquired from the ground water, as is the fluorine, differential absorption depending upon bone porosity would seem to be common to both.

The effects of varying rates of ground-water circulation, of temperature changes, both seasonal and major-climatic, and the local effects of an erratic flowstone cover doubtless contribute to the rate of fluorine absorption.

Despite these disturbing possibilities, it is encouraging to note that the three species of mammals highest in fluorine content are known to have been associated in late Pleistocene times: New Paris No. 4, Pennsylvania, and Natural Chimneys, Virginia (Guilday, 1962). None occur at these sites today. The range of the yellow-cheeked vole (*M. xanthognathus*) has retreated, following deglaciation, 1200 miles to the northwest (fig. 4, map 1A); that of the thirteen-lined ground squirrel (*Citellus tridecemlineatus*) (fig. 4, map 1B) at least 500 miles to the west. The

red-backed vole (*Clethrionomys*) is still found in northern Pennsylvania and extends south along the mountain ridges.

The three species with the lowest percentage of fluorine, the box turtle (*Terrapene carolina*), the rabbit (*Sylvilagus*) (fig. 4, map 4), and the deer (*Odocoileus*) are temperate species that all inhabit the area today.

Because of the many uncontrolled factors that might influence the fluorine content, the percentages given here are not necessarily a direct function of time. But the general picture seems to indicate continuous deposition from a boreal to a temperature climate. The carbon<sup>14</sup> date, which provides a minimum date for the formation of the breccia, is well within Recent times,  $3,722 \pm 200$  years (Before Present). (Sample No. 10-29-4, Gulf Research and Development Co. laboratory, Harnarville, Pa.)

#### FAUNAL LIST, BOOTLEGGER SINK

##### DIPLOPODA identified by Nell B. Causey

<i>Conotyla</i> , ?species	millipede
? <i>Apheloria</i> , species	millipede

##### GASTROPODA

<i>Triodopsis albolabris</i>	snail
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##### AMPHIBIA identified by Neil D. Richmond

###### Order Caudata—salamander

unidentified salamander, 3 vertebrae

###### Order Salientia

###### Family Pelobatidae

<i>Scaphiopus</i>	spadefoot toad, 1 vertebra
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###### Family Bufonidae

<i>Bufo americanus</i>	American toad, 1 ilium
<i>Bufo woodhouseii fowleri</i>	Fowler's toad, 1 ilium, 1 fronto-parietal

###### Family Hylidae

<i>Hyla</i> , ?species	tree frog
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###### Family Ranidae

<i>Rana pipiens</i>	leopard frog
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##### REPTILIA identified by Neil D. Richmond

###### Order Chelonia

###### Family Testudinidae

<i>Terrapene carolina</i>	box turtle
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Order Serpentes  
Family Colubridae

<i>Carphophis</i> cf. <i>amoena</i>	worm snake
<i>Coluber</i> cf. <i>constrictor</i>	black racer
<i>Lampropeltis calligaster</i> <i>rhombomaculata</i>	mole snake
<i>Thamnophis</i> cf. <i>sirtalus</i>	garter snake

Family Crotalidae  
*Crotalus* cf. *horridus* rattlesnake  
*Ancistrodon* cf. *contortrix* copperhead

## MAMMALIA

Minimum number of  
individuals

Order Insectivora  
Family Soricidae

<i>Sorex</i> cf. <i>cinereus</i>	masked shrew	1
<i>Sorex arcticus</i>	Arctic shrew	1
<i>Microsorex hoyi</i>	pygmy shrew	1
<i>Blarina brevicauda</i>	short-tailed shrew	2
<i>Cryptotis parva</i>	least shrew	1

Family Talpidae		
<i>Parascalops breweri</i>	hairy-tailed mole	1
<i>Condylura cristata</i>	star-nosed mole	1

Order Chiroptera  
Family Vespertilionidae

<i>Myotis</i> cf. <i>keenii</i>	Keen's bat	8
<i>Myotis</i> cf. <i>lucifugus</i> or <i>keenii</i>	little brown bat	8
<i>Pipistrellus</i> cf. <i>subflavus</i>	pipistrelle	2
<i>Eptesicus</i> cf. <i>grandis</i>	big brown bat	1
<i>Plecotus</i> sp.	long-eared bat	3

Order Lagomorpha  
Family Leporidae

<i>Sylvilagus</i> cf. <i>floridanus</i>	cottontail rabbit	1
<i>Sylvilagus</i> sp.	cottontail rabbit	4

Order Rodentia  
Family Sciuridae

<i>Tamias striatus</i>	chipmunk	4
<i>Marmota monax</i>	woodchuck	3
<i>Citellus tridecemlineatus</i>	thirteen-lined ground squirrel	1
<i>Sciurus</i> sp.	gray or fox squirrel	1
<i>Tamiasciurus hudsonicus</i>	red squirrel	1
<i>Glaucomys volans</i>	southern flying squirrel	1
<i>Glaucomys sabrinus</i>	northern flying squirrel	1

		Minimum number of individuals
	Family Cricetidae	
<i>Peromyscus</i> cf. <i>leucopus</i>	white-footed mouse	1
<i>Peromyscus</i> cf. <i>maniculatus</i>	deer mouse	1
<i>Peromyscus</i> sp.		6
<i>Clethrionomys gapperi</i>	red-backed vole	10
<i>Microtus pennsylvanicus</i>	meadow vole	5
<i>Microtus chrotorrhinus</i>	rock vole	1
<i>Microtus xanthognathus</i>	yellow-cheeked vole	3
<i>Microtus</i> sp.		2
<i>Pitymys pinetorum</i>	pine vole	1
<i>Synaptomys borealis</i>	northern bog lemming	3
	Family Zapodidae	
<i>Napaeozapus insignis</i>	woodland jumping mouse	2
	Family Erethizontidae	
<i>Erethizon dorsatum</i>	porcupine	4
	Order Carnivora	
	Family Canidae	
<i>Canis</i> sp.	dog or small wolf	1
<i>Vulpes</i> sp.	red fox	1
	Family Mustelidae	
<i>Mustela</i> sp.	weasel	1
<i>Mephitis mephitis</i>	striped skunk	5
<i>Lutra canadensis</i>	otter	1
	Order Artiodactyla	
	Family Cervidae	
<i>Odocoileus virginianus</i>	white-tailed deer	1
<i>Rangifer</i> cf. <i>tarandus</i>	caribou	1

## ANNOTATED LIST, BOOTLEGGER SINK LOCAL FAUNA

### AMPHIBIANS AND REPTILES

One left ilium of a toad-sized salientian (CM 7954, fig. 3) cannot be identified. The high ilial crest and the position of the ilial prominence (much farther back than in *Bufo*) make a unique combination. It is figured with no additional comment. If more specimens are recovered it may be well worth describing as a new form.

The presence of the box turtle (*Terrapene carolina*) is an indication of temperate conditions, incompatible with the boreal elements of the fauna. Its absence from the extensive boreal fauna of New Paris No. 4,



plus the low fluorine value for the Bootlegger Sink specimen, would indicate a relatively late date for its inclusion even though it was almost encased in travertine.

The mole snake (*Lampropeltis calligaster rhombomaculata*) no longer occurs as far north as Pennsylvania (fig. 4, map 1C). This species and the long-eared bat (*Plecotus*) probably date from the Hypsithermal Interval. All other species occur at least as far north as the site today.

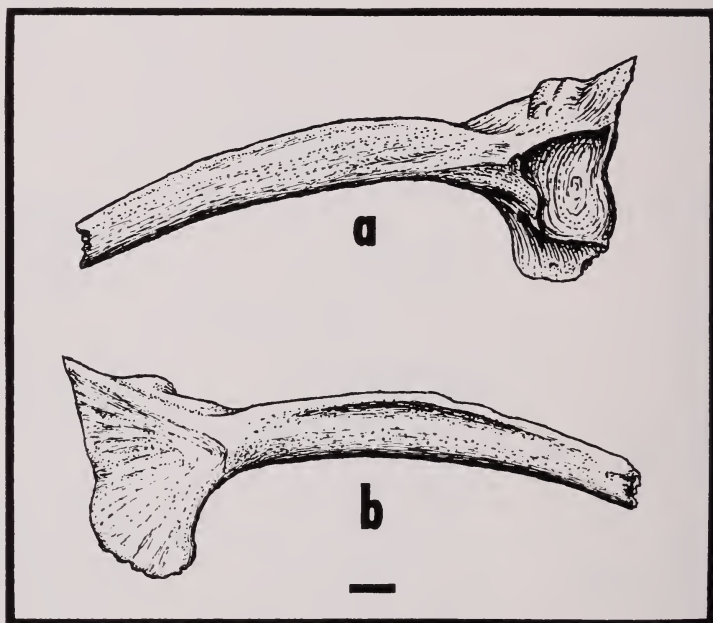


Fig. 3 Salientia, ?species. CM 7954. Left ilium. a. External view. b. Internal view. Bar = 2 mm.

#### MAMMALS

Order Insectivora

Family Soricidae

*Sorex* cf. *cinereus* Kerr—Masked shrew

MATERIAL: CM 7925-27. Two left, 1 right mandible.

REMARKS: The identification remains provisional because of the possibility of confusion with *S. longirostris*. *Sorex longirostris* has never been recorded north of Maryland (Hall and Kelson, 1959), but the presence of *Plecotus* in the Bootlegger Sink local fauna makes it probable that other southern forms might be present as well.

*Sorex arcticus* Kerr—Arctic shrew

MATERIAL: CM 7921. One left mandible.

REMARKS: Confined to the Canadian life zone today (fig. 4, map 2A), this shrew ranged as far south as Natural Chimneys, Virginia, and Robinson Cave, Tennessee (McCrary and Schmidt, 1963), during the late Pleistocene.

*Microsorex hoyi* (Baird)—Pygmy shrew

MATERIAL: CM 7922. One partial skull; 1 left, 1 right mandible.

REMARKS: Although this nominally northern shrew does occur as far south as Washington, D. C. (Bailey, 1923), there is only one modern record for Pennsylvania, (Roshund, 1951, p. 40). It was common in the late Pleistocene New Paris No. 4 local fauna.

*Blarina brevicauda* (Say)—Short-tailed shrew

MATERIAL: CM 7924. One P<sup>4</sup>, 1 M<sup>1</sup>; 1 left, 2 right mandibles; 1 I<sub>1</sub>; 1 humerus.

*Cryptotis parva* (Say)—Least shrew

MATERIAL: CM 7923. One mandible (sacrificed for spectrochemical analysis); 1 left maxilla.

REMARKS: A field-inhabiting form of southern affinities. (fig. 4, map 2B). Present in the area today, *Cryptotis parva* was probably not a member of the boreal fauna. The material proved to be inadequate for spectrochemical analysis.

## Family Talpidae

*Parascalops breweri* (Bachman)—Hairy-tailed mole

MATERIAL: CM 7961. One left M<sub>1</sub>, M<sub>2</sub>; 1 right radius.

REMARKS: The hairy-tailed mole does not inhabit the Piedmont Province today. It is common in the Ridge and Valley Province, the Appalachian Plateau, and the Pocono Mountains. *Scalopus aquaticus*, the common mole of the eastern seaboard area and York County, was not present in the deposit.

*Condylura cristata* (Linnaeus)—Star-nosed mole

MATERIAL: CM 7962. One left, 1 right lower molar; 1 right humerus; 1 left tibia.

## Order Chiroptera

## Family Vespertilionidae

*Myotis cf. keenii* (Merriam)—Keen's bat

MATERIAL: CM 7929-7934, CM 7936-7940, CM 7946-7947. One partial skull; 2 right maxillae; 2 left, 8 right mandibles.

*Myotis cf. lucifugus* or *keenii*—Little brown bat

MATERIAL: CM 7935, CM 7941-7943, CM 7945, CM 7955-7957. Eight left, 3 right fragmentary mandibles.

*Pipistrellus cf. subflavus* (F. Cuvier)—Pipistrelle

MATERIAL: CM 7958-7960. One left maxilla; 2 right mandibles.

*Eptesicus cf. grandis* (Brown)—Brown's brown bat

MATERIAL: CM 7963. One partial right mandible, P<sub>4</sub>-M<sub>3</sub>; 1 upper canine.

*Plecotus* sp.—Long-eared bat

MATERIAL: CM 7944, CM 7964. Three left, 1 right partial mandibles; 1 M<sub>1</sub>. (Two of the mandible fragments, 1 left, 1 right, were sacrificed for spectrochemical analysis, but the sample proved inadequate.)

REMARKS: This is the third known locality for *Plecotus* north of its present range in the Appalachians. (fig. 4, map 3B). [*Plecotus* sp., Frankstown Cave, Blair County, Pennsylvania (Guilday, 1961), and *Plecotus alleganiensis* (Gidley and Gazin, 1938) from Cumberland Cave, Maryland, cannot be dated and may be pre-Wisconsin age]. The Bootlegger Sink specimens are post-Wisconsin and probably date to the Hypsithermal Interval. All other species recovered from this deposit with the exception of the mole snake (fig. 4, map 1C) occur either at the site or north of it today.

## Order Lagomorpha

## Family Leporidae

*Sylvilagus* cf. *floridanus* (J. A. Allen)—Cottontail rabbit

MATERIAL: CM 8003. One right frontal.

REMARKS: Identification based upon characteristic pre- and post-orbital processes.

*Sylvilagus*, ?sp.—probably *floridanus* or *transitionalis*

MATERIAL: CM 8004. One right mandible, 1 right ascending ramus of mandible with coranoid process.

cf. *Sylvilagus*, ?species

MATERIAL: CM 8005. Four left, 1 right partial mandible; 3 fragmentary right innominates; 5 cervical, 3 thoracic vertebrae; 1 left, 1 right humerus; 3 calcanea; 1 navicular; fragments of femur, radius, ulna, metatarsus, maxillae.

## Order Rodentia

## Family Sciuridae

*Tamias striatus* (Linnaeus)—Chipmunk

MATERIAL: CM 7899, CM 7976, CM 7979. One left, 4 right partial mandibles; 1 left maxilla P<sup>1</sup>-M<sup>2</sup>; 1 partial skull, no dentition.

*Marmota monax* Linnaeus—Woodchuck

MATERIAL: CM 8002. Three right mandibles.

REMARKS: Portions of one mandible were sacrificed for spectrochemical analysis.

*Citellus tridecemlineatus* (Mitchell)—Thirteen-lined ground squirrel

MATERIAL: CM 7894. CM 7975. One right maxilla, P<sup>1</sup>-M<sup>2</sup>; 1 left, 1 right M<sub>3</sub>. CM 7920. One partial right mandible, P<sub>4</sub>-M<sub>2</sub>.

REMARKS: Now confined to the prairie of central North America except for a feral colony in northwestern Pennsylvania (Richmond and Roslund, 1949) (fig. 4, map 1B), this ground squirrel was widely distributed in the east during late Pleistocene times. It has been recovered from New Paris No. 4, Pennsylvania; Cumberland Cave, Maryland; Natural Chimneys, Virginia; and Robinson Cave, Tennessee.

*Sciurus*, ?sp. —Gray or fox squirrel

MATERIAL: CM 7992. One right M<sup>3</sup>, badly worn.

*Tamiasciurus hudsonicus* (Erxleben)—Red squirrel

MATERIAL: CM 7974. One left M<sup>2</sup>; 1 left premaxilla with incisor; 1 left, 1 right frontal bone.

*Glaucomys volans* (Linnaeus)—Southern flying squirrel

MATERIAL: CM 7980. One left mandible, P<sub>4</sub>-M<sub>1</sub>.

*Glaucomys sabrinus* (Shaw)—Northern flying squirrel

MATERIAL: CM 7977. One right M<sub>2</sub>.

REMARKS: Referred to *G. sabrinus* on the basis of its large size. It agrees with New Paris No. 4 referred specimens.

## Family Cricetidae

*Peromyscus* cf. *leucopus* (Rafinesque)—White-footed mouse

MATERIAL: CM 7972. One left M<sub>1</sub>.

*Peromyscus* cf. *maniculatus* (Wagner)—Deer mouse

MATERIAL: CM 7971. One right maxilla with M<sup>1</sup>.

*Peromyscus*, ?species

MATERIAL: CM 7969, CM 7970, CM 7973. Two left, 6 right mandibles; 1 left, 2 right maxillae; 17 molars.

*Clethrionomys gapperi* (Vigors)—Red-backed vole

MATERIAL: CM 7914-7917, CM 8010. Two partial skulls; 1 left, 1 right maxilla; 4 left, 10 right mandibles and/or M<sub>1</sub>'s.

REMARKS: This was the commonest mammal in the deposit. The red-backed vole no longer occurs in York County although it is common in cool mountain forests throughout the state and occurs in South Mountain in neighboring Lancaster County (Roberts and Early, 1952: 52).

*Microtus pennsylvanicus* (Ord)—Meadow vole

MATERIAL: CM 7905-7909, CM 7911. Five partial skulls; 1 left, 1 right maxilla.

*Microtus chrotorrhinus* (Miller)—Rock vole

MATERIAL: CM 7901. One partial skull, left M<sup>3</sup> missing, otherwise full dentition.

REMARKS: This vole occurs as a boreal relict as far south as the peaks of the Great Smoky Mountains. It has been taken in a few localities in northern Pennsylvania but does not occur in York County today (Roslund, 1951). It was apparently much more widespread during the boreal climate of the late Pleistocene. It was common in the New Paris No. 4, Pennsylvania, local fauna and also has been recovered from the Natural Chimneys, Virginia, local fauna.

*Microtus xanthognathus* (Leach)—Yellow-cheeked vole

MATERIAL: CM 7902-7904. Three right mandibles; 1 right M<sup>3</sup>; 1 left innominate; 1 tibia.

REMARKS: This vole ranges throughout the Hudsonian life zone of western Canada from Churchill, Manitoba (1200 mi. northwest of Bootlegger Sink) north and west to Alaska (fig. 4, map 1A). This is the third known late Pleistocene record of this species in the Appalachians. It is known from New Paris No. 4, Pennsylvania, (over 300 individuals) and from Natural Chimneys, Virginia.

*Pitymys pinetorum* (La Conte)—Pine Vole

MATERIAL: CM 7913. One left, 1 right mandible.

REMARKS: The commonest microtine at the site today.

*Synaptomys borealis* (Richardson)—Northern bog lemming

MATERIAL: CM 7892, CM 7893, CM 7918, CM 7965. Two right, 1 left mandible; 1 right M<sub>1</sub>.

REMARKS: This boreal rodent, found over a large portion of forested Canada, enters the United States only in Minnesota and the northern Appalachians as far south as New Hampshire's White Mountains. It occurred as far south as Natural Chimneys, Virginia, during the late Pleistocene and also has been recorded from Robinson Cave, Tennessee, Cumberland Cave, Maryland, and New Paris No. 4, Pennsylvania.

## Family Zapodidae

*Napaeozapus insignis* (Miller)—Woodland jumping mouse

MATERIAL: CM 7982-7983. One left maxilla with M<sup>1</sup> and M<sup>3</sup>; 1 right M<sub>1</sub>, M<sub>2</sub>; 6 upper molars; 2 upper incisors.

REMARKS: Largely confined to upland forests of the state, the woodland jumping mouse does not occur at the site today.

## Family Erethizontidae

*Erethizon dorsatum* (Linnaeus)—Porcupine

MATERIAL: CM 7998-8001. Four partial skulls; 1 left, 3 right mandibles. Isolated molars; incisors; 1 left humerus, 2 vertebrae; numerous fragmentary limb bones.

REMARKS: Not a member of the Recent fauna of York County, the porcupine is confined to the mountain forests of the state today.

## Order Carnivora

## Family Canidae

*Canis* sp.—Small wolf or dog

MATERIAL: CM 7997. One right humerus; 1 left, 1 right partial tibia; 1 partial left ulna.

REMARKS: The late date for the formation of the breccia makes Indian dog a distinct possibility. Compared with dog skeletal material from an early 17th-century Indian site in Lancaster County (Site No. 36-La-12 at Washington Boro) the bones are of comparable length and but slightly stouter.

cf. *Vulpes*, ?species probably Red fox

MATERIAL: CM 8007. One upper right canine.

## Family Mustelidae

*Mustela* sp.—Small weasel

MATERIAL: CM 7987, CM 8006. One left M<sup>1</sup>; 1 right P<sup>4</sup>.

*Mephitis mephitis* (Schreber)—Striped skunk

MATERIAL: CM 7989-7991, CM 7993-7996. Five partial skulls; 4 left, 2 right mandibles; fragmentary limb bones; isolated canines.

*Lutra canadensis* (Schreber)—Otter

MATERIAL: CM 7988. One left mandible, full dentition.



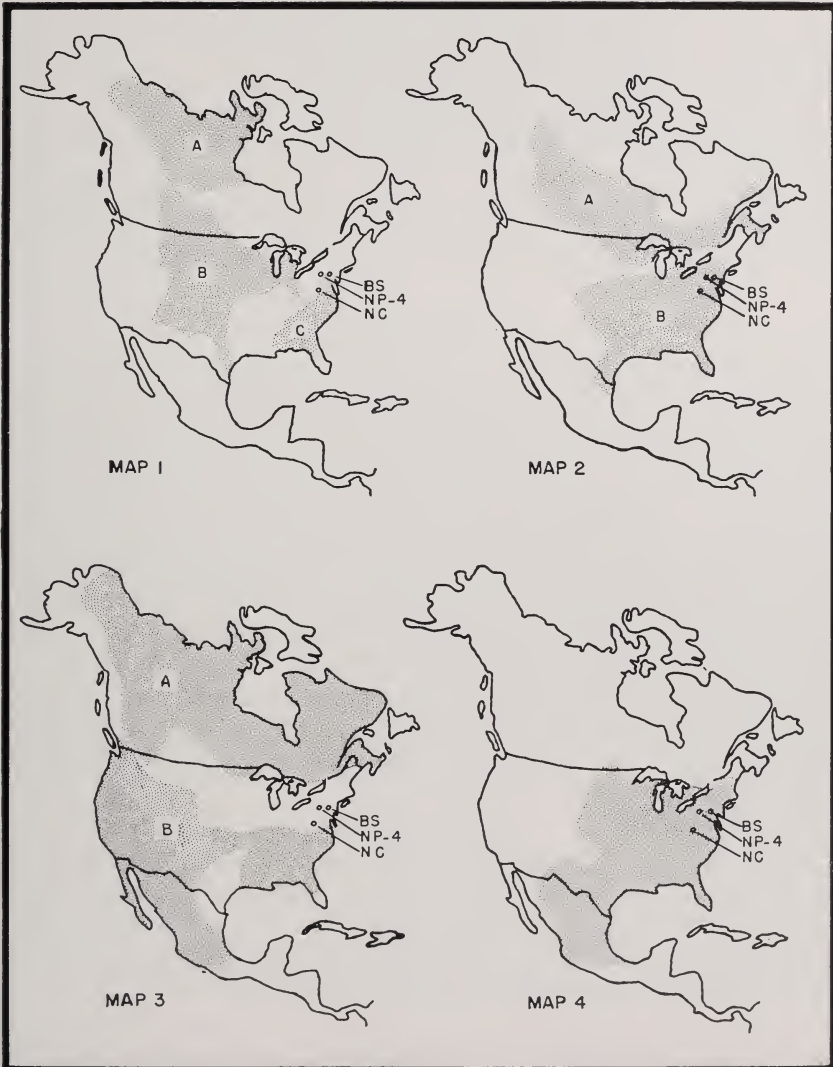


Fig. 4 Modern North American distribution of selected species from the Bootlegger Sink Local Fauna. BS = Bootlegger Sink, Pennsylvania. NP-4 = New Paris No. 4, Pennsylvania. NC = Natural Chimneys, Virginia. Map 1: A. *Microtus xanthognathus*, B. *Citellus tridecemlineatus*. C. *Lampropeltis calligaster rhombomaculata*. Map 2: A. *Sorex arcticus*. B. *Cryptotis parva*. Map 3: A. *Rangifer tarandus*. B. *Plecotus*. Map 4: *Sylvilagus (floridanus plus transitionalis)*.

## Order Artiodactyla

## Family Cervidae

*Odocoileus virginianus* (Zimmermann)—White-tailed deer

MATERIAL: CM 8008. Two ungual phalanges, 1 second phalanx; fragments of metatarsal, ilium, femur, distal metapodial epiphysis.

*Rangifer cf. tarandus* (Linnaeus)—Caribou

MATERIAL: CM 7986. One right cuneiform; 1 right unciform; 1 ungual phalanx; 1 accessory phalanx.

REMARKS: Caribou remains are scarce from Pleistocene deposits in the East. They have been reported from only one other site in the state: Hartman's Cave, Monroe County (Leidy, 1889). See fig. 4, map 3A for modern range.

## DISCUSSION

The Bootlegger Sink local fauna is mixed both chronologically and ecologically. Based upon modern habitat requirements it is impossible to imagine that all the species recovered from the breccia deposit were contemporaneous. It is unrealistic to visualize a situation in which the least shrew (*Cryptotis parva*) (fig. 4, map 2B) and the cottontail rabbit (*Sylvilagus*) (fig. 4, map 4) could co-exist with the yellow-cheeked vole (*Microtus xanthognathus*) (fig. 4, map 1A) and the arctic shrew (*Sorex arcticus*) (fig. 4, map 2A). The wide range of fluorine values calls for a long period of accumulation. The C<sup>14</sup> date provides a minimum date for the brecciation that is well within Recent times. Except for numerous, unidentified fungus spores the pollen analysis was negative. On the basis of the present evidence, deposition began during late glacial times, 10,000 to 15,000 years ago, and continued to the period of brecciation, 3000 to 4000 years ago.

A stratigraphic key to small mammal successions during the late glacial period in the central Appalachians is provided by the New Paris No. 4 local fauna, about 200 miles west of Bootlegger Sink and 1200 feet higher. Using this fauna as an indicator of late glacial changes, and the modern fauna of York County as indicative of the Recent past, the Bootlegger Sink local fauna could be separated as follows:

TABLE 1

PROBABLE CHRONOLOGICAL DISTRIBUTION OF MAMMALS  
FROM THE BOOTLEGGER SINK BRECCIA

Species	Late Glacial ca. 8000 B.C. (cold fore-glacial climate)	Hypsithermal ca. 3000 B.C. (period of maximum warmth)	Recent ca. 1758 A.D. (modern climate)
<i>Parascalops breweri</i>	P	-	-
<i>Condylura cristata</i>	P	P	P
<i>Cryptotis parva</i>	-	P	P
<i>Blarina brevicauda</i>	P	P	P
<i>Microsorex hoyi</i>	P	?	?
<i>Sorex arcticus</i>	P	-	-
<i>Sorex cinereus</i>	P	P	P
<i>Pipistrellus</i>	?	P	P
<i>Eptesicus</i>	P	P	P
<i>Plecotus</i>	-	P	-
<i>Myotis cf. keenii</i>	P	P	P
<i>Myotis cf. lucifugus</i>	P	P	P
<i>Tamias striatus</i>	P	P	P
<i>Marmota monax</i>	?	P	P
<i>Citellus tridecemlineatus</i>	P	-	-
<i>Tamiasciurus hudsonicus</i>	P	P	P
<i>Sciurus</i>	-	P	P
<i>Glaucomys volans</i>	-	P	P
<i>Glaucomys sabrinus</i>	P	-	-
<i>Peromyscus cf. leucopus</i>	-	P	P
<i>Peromyscus cf. maniculatus</i>	P	-	-
<i>Synaptomys borealis</i>	P	-	-
<i>Clethrionomys gapperi</i>	P	-	-
<i>Microtus pennsylvanicus</i>	P	P	P
<i>Microtus chrotorrhinus</i>	P	-	-
<i>Microtus xanthognathus</i>	P	-	-
<i>Pitymys pinetorum</i>	-	P	P
<i>Napaeozapus insignis</i>	P	-	-
<i>Erethizon dorsatum</i>	P	-	-
<i>Sylvilagus, sp.</i>	-	P	P
<i>Vulpes</i>	P	-	-
<i>Canis (dog ?)</i>	-	P	P
<i>Mustela sp.</i>	P	P	P
<i>Lutra canadensis</i>	P	P	P
<i>Mephitis mephitis</i>	?	P	P
<i>Rangifer cf. tarandus</i>	P	-	-
<i>Odocoileus cf. virginianus</i>	-	P	P

---

P=present

-=absent

Assignment of species to the Late-Glacial, Hypsithermal and sub-Recent is based upon the known faunas of Late-Glacial (New Paris No. 4), Hypsithermal (Sheep Rock Shelter, in part, Guilday and Parmalee, 1965) and sub-Recent (various archeological) sites in the state. (Guilday, Parmalee and Tanner, 1962). The Late-Glacial climate was boreal, quite different from the warmer Hypsithermal and sub-Recent. The Hypsithermal is believed to have been somewhat warmer and drier than at present.

If the period assignments are correct, and some are admittedly speculative, 35 per cent of the Bootlegger mammalian fauna (13 species) was deposited during the Late-Glacial period, 2.7 per cent (1 species) during Hypsithermal times, and 24 per cent (9 species) during the sub-Recent. The remaining 38 per cent (14 species) could have been deposited at any time from the Late-Glacial onwards.

The Bootlegger Sink local fauna is important in that it demonstrates that boreal forms now restricted to high latitudes or altitudes ranged during Late-Glacial times into the Piedmont of the eastern seaboard. Heretofore, all known cave sites producing boreal Pleistocene faunas had been confined to either the Ridge and Valley province, or the Appalachian/Cumberland Plateau region of the midwest. This is the second record of the caribou from Pennsylvania. The presence of the thirteen-lined ground squirrel in the deposit demonstrates that at least some nominally western forms reached the Atlantic seaboard during the Late-Glacial.

It also documents two northerly range extensions. The mole snake (*Lampropeltis c. rhombomaculata*) (fig. 4, map 1C) and the long-eared bat (*Plecotus* sp.) (fig. 4, map 3B) both extended their ranges north possibly one hundred miles. This is probably associated with the warm, dry Hypsithermal Interval (ca. 3000 B.C.).

Only a small section of the bone-bearing breccia was examined. If the site is excavated as planned by a joint North Museum-York Grotto, National Speleological Society group, more of the post-glacial history of the cave and of the York County area will be learned from the tons of matrix still remaining in Bootlegger Sink.

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# A COLLECTION OF PREHISTORIC ARTIFACTS FROM THE DANISH ISLES

(Carnegie Museum Accession No. 19770)

BIRGITTA LINDEROTH-WALLACE

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## INTRODUCTION

This is a collection of 335 artifacts, most of them made of flint. While it is not certain that they were brought to this country by or through C. V. Hartman, the probability is that they were, even though they are registered as received from an "Unknown Donor." The date of their accession is entered as 14 July, 1961, and their Accession Number is 19770. Following is a statement on Hartman and his activities.

From an Annual Report (Publ. Carnegie Mus., 1903) prepared by W. J. Holland:

"Mr. C. V. Hartman has been appointed as Curator of Ethnology and Archaeology. Mr. Hartman, who, it may be incidentally mentioned, bears an honored name, being the son of the most famous of recent Swedish botanists, who holds in his own country a position comparable to that which was held by the late Professor Asa Gray in this country, was the associate of Professor Karl Lumholtz in his ethnological and archaeological investigations in Mexico. He is the author of a magnificent work upon the antiquities of Costa Rica, published by the Royal Geographical Society of Sweden. Mr. Hartman, acting under the instruction of the Director, after conference with him, has been deputed to make some further investigations in the Central American countries, with a view to the acquisition by this Museum of material illustrative of the ancient Aztec civilization, as well as of the natural history of these countries."

Submitted for publication April 23, 1963

Issued November 28, 1966

Recently a similar collection of Danish Neolithic stone artifacts in the Department of Geology of Princeton University was examined by Mrs. Wallace. The items in that collection bear labels similar to those on Accession No. 19770. The Princeton collection was bought from Wards around 1875. As Carnegie Museum in its early years also bought from Wards, it is not unlikely that 19770 came from this source.

Most of the specimens described in this article have no provenience records, but we believe all were manufactured on the Danish Isles.

Those artifacts that do have provenience records are, with one exception, from northwestern Jutland, and were found during the period 1882 to 1898. These (Nos. 246 through 279) are all Neolithic and are grouped according to location. In the catalog they follow all other Neolithic implements.

With few exceptions rough dating of the objects was possible. They belong to eight, possibly nine, culture levels. In the catalog they are listed in chronological order.

The size of implements in the illustrations is indicated by a 15-cm. scale.

#### PERIODS REPRESENTED IN THE COLLECTION

The datings in this tabulation follow Brøndsted, (1957, 1958, 1960).

##### PALEOLITHIC

*Bromme*: 10,000 B.C.

##### MESOLITHIC

*Klosterlund*: 7500-7000 B.C.

*Ertebølle* or *Coastal Culture*: 5000-2000 B.C.

(The date 2000 B.C. for the final disappearance of the Ertebølle Culture is not firm.)

1. Early: 5000-2700 B.C.

##### NEOLITHIC

2. Late: 2700-2000 B.C.

*Funnel-necked Beaker Culture*: 2600-1800 B.C.

1. A-Culture: 2600-2500 B.C.

2. B-Culture: 2500-2400 B.C.

3. C-Culture: 2400-2300 B.C. (A, B, and C constitute the early Neolithic of some authors.)

4. D-Culture: 2300-2000 B.C. (This is the middle Neolithic I, II, and III of some authors.)

*Megalithic*

Dolmen time

Passage Grave time

5. E-Culture: 2000-1800 B.C. (This is the middle Neolithic IV and V of some authors.)

*Pitted Ware Culture*: about 2000 B.C.

*Single Grave Culture*: 2000-1800 B.C. (middle Neolithic IV and V.)

1. In Jutland: 2000-1800 B.C.

a. Bottom Grave time

b. Ground Grave time

c. Upper Grave time

2. On the Isles: 1900-1800 B.C. (middle Neolithic V.)

Stone cist  
time.

{ *Dagger Period*: 1800-1500 B.C. (This is the late Neolithic of some authors.)

BRONZE AGE

{ *Bronze Age, Period I*: 1500-1300 B. C.

IRON AGE

? Probably late Iron Age: A.D. 400-1100

Since this paper was written in 1962 more radiocarbon dates for the beginning of the Neolithic in Denmark have become available (cf. Tauber, 1960:7; 1964:217-218; Thomas, 1965: 382-392). They indicate the Neolithic stage may have begun far earlier in Denmark than was formerly believed, although there is still too little dated material to produce any firm dating of the above periods. More excavations and scientific tests are needed before we get a clear picture of the actual happenings. A tentative table, based on the most recent data, is given below:

*Funnel-necked Beaker Culture*:

A. 2900-2700 B.C. (early Neolithic I)

B. 2700-2600 B.C. (early Neolithic II)

C. 2600-2500 B.C. (early Neolithic III)

D. 2500-2300 B.C. (middle Neolithic I to III)

E. 2300-1800 B.C. (middle Neolithic IV to V)

*Pitted Ware Culture*: 2300 B.C.

*Single Grave Culture*: 2300-1800 B.C. (early middle Neolithic III or late IV to V)

*Dagger Period*: 1800-1500 B.C. (late Neolithic)

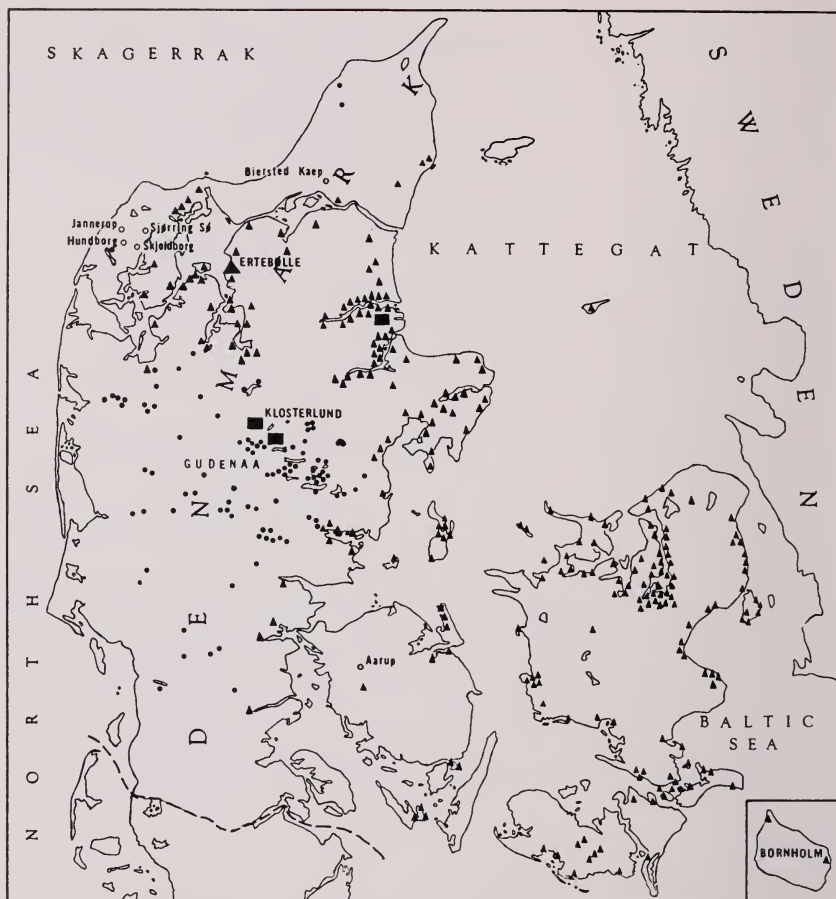


Fig. 1. Map of present day Denmark. ■ Klosterlund sites; ▲ Ertebølle sites; ● Gudena sites. Labels Ertebølle and Klosterlund indicate type sites. (From Brøndsted, 1957, 1:90, with additions.)

### MESOLITHIC

**KLOSTERLUND:** Klosterlund existed when the climate was of a pre-boreal type. Thin pine woods began to replace the more arctic dwarf birch. The fauna included aurochs, horses, and wolves. The economy was based on hunting and gathering.

While an axe-like tool made of reindeer antler reinforced with a flint tip had been used by people of cultures earlier than Klosterlund, it was

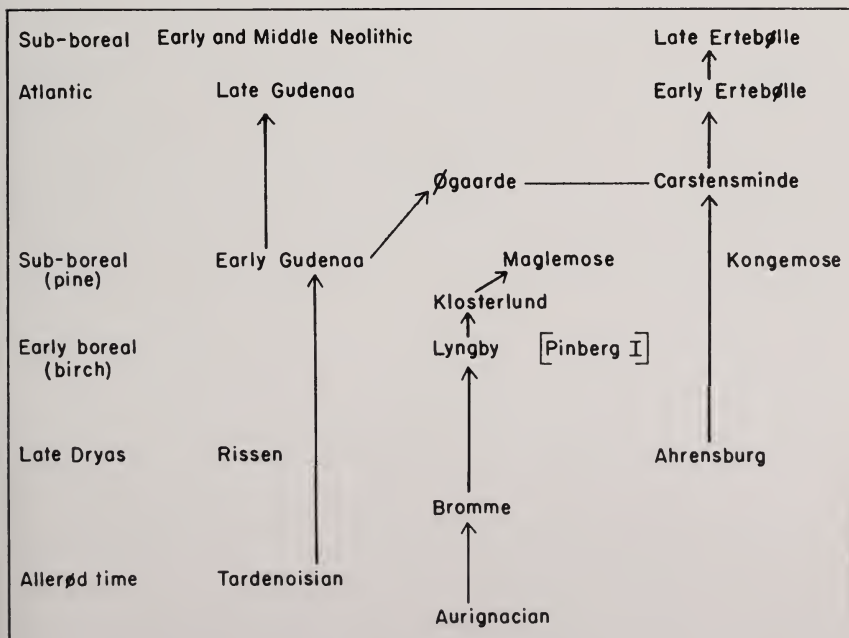


not until Klosterlund times that true flint axes were made. They were crude core axes without real cutting edges, but they were the first flint axes in Scandinavia.

Most Klosterlund flint work was crude. The flakes were struck from small and poorly prepared cores. Microliths were used, and small scrapers are the tools most commonly represented in collections.

Klosterlund had much in common with the German Duvensee Culture which had its roots in the late Tardenoisian Period (Mathiassen, 1937: 154).

**ERTEBØLLE CULTURE:** Early Ertebølle and Late Ertebølle cultures, also known as Early and Late Coastal cultures, were coexistent with an inland culture, Gudenaa. The climate of the period originally was a mild "Atlantic" type. Then a slight climatic change, beginning about 2500 B.C., brought warmer, dryer summers and colder winters. This change lasted until about 400 B.C., and has been labeled a sub-boreal period. It had little effect on the Ertebølle people. Large oak forests replaced the pine woods of the period of the Klosterlund people. The fauna included deer, fox, wild boar, beaver, and bear. The people had domesticated dogs.



The economy was based on hunting, gathering, and fishing. The people collected and consumed great quantities of oysters and other shellfish, whose discarded shells produced the vast middens that suggested the name kitchen-midden by which some authors designate this culture.

Flint work was based mainly upon techniques suitable for the manufacture of macrolithic implements. Blades were long and elegant, and both core and flake axes were made. Axes were made of such stone as gneiss, greenstone, and slate, as well as flint.

During the late Coastal Culture days, pottery was made. Axes were more finely chipped, their cutting edges sharper than in Early Coastal Culture days.

## NEOLITHIC

**FUNNEL-NECKED BEAKER CULTURE:** In the early Neolithic I two waves of Neolithic immigrants reached Denmark within an interval of less than a century (Brøndsted, 1957, 1:144-147). (Some authors consider the Funnel-necked Beaker Culture an indigenous development of the Ertebølle Culture; cf. Troels-Smith, 1953:42-43.) These immigrants were related to the Central European Funnel-necked Beaker Culture. In Denmark they are named after their pottery, which has been divided into five phases, the A, B, C, D, and E types, a terminology introduced by Becker (1947:35-317). We here call them the A, B, C, D, and E Cultures. The radiocarbon-dating method has given the year  $2620 \pm 80$  B.C. (Tauber, 1956:879-881; Troels-Smith, 1956:879) for a settlement with A pottery, and B pottery is probably a little younger than A (Becker, 1947:90-91). But few aspects of A- and B-Cultures are known. Some authors have suggested that they were contemporary and that they are older than indicated above (Hinsch, 1955:115-120, 129-136). Parallels to pottery of A-type have been found in eastern Germany and Poland, and to B-type at Michelsberg, situated in the central part of the Rhine Valley (Becker, 1947:262).

These people were agricultural folk employing a slash-and-burn technique to clear tillable fields. Pollen analysis proved there was a sudden retreat of the elm forest in the areas where these people settled, and this retreat may well be due to devastation wrought by their primitive land-clearing technique (Iversen, 1941).

Axes, beautiful in form and suitable for felling large trees, were the chief tools of the Neolithic people. The earliest, which the A-people

either brought with them or developed after their arrival, are known as the Point-butted. The diagnostic axes of the B-people are known as Thin-butted. They copied, in flint, metal axes already in use in other parts of Europe. Thin-butted axes of enormous size are found by today's archeologists. Such axes must have been too large for practical use, and it has been suggested that they were trading units or religious symbols. Due to development of new hafting methods, Thin-butted axes were eventually displaced by Thick-butted ones. Other types of axe such as Thin-bladed, Furrowed, and the like, were used during the time of the Funnel-necked Beaker Culture people.

The A- and B-cultures eventually merged and from the merger rose the C- and D-cultures. With the C-Culture began the custom of constructing megaliths in Denmark (probably early in the period).

**PITTED WARE CULTURE:** Denmark suffered several invasions in the middle Neolithic (late III or early IV). While it is not unlikely that pockets of the Late Ertebølle Culture and Gudenaa Culture existed at this time (Mathiassen, 1937:124-125) they were without doubt pushed off to unfavorable locations away from lands the Neolithic peoples found attractive. The Late Ertebølle and Gudenaa peoples had to compete not only with the Funnel-necked Beaker Culture people, who already had begun to filter into Denmark in the early Neolithic, but also with a new group of Neolithic folk. These were the Pitted Ware (or Pock-marked Ware) Culture people of eastern Sweden, who pushed down from southern Sweden across the Danish Isles (Becker, 1950).

In addition to its pitted (or pock-marked) ceramics, the Pitted Ware Culture was characterized by long, slender arrow-points with triangular cross-sections. Evidently contact between the Pitted Ware Culture folk and other contemporary Danish cultures was not peaceful, as attested by the finding of skeletons with arrow-points of this type in them (Brøndsted, 1957, 1:247-248).

The greatest threat to the Megalith people came from the south. Again in the middle Neolithic, hordes of people known in Denmark as the Single Grave Culture started to move into Denmark, first by way of the Jutland Peninsula, and later to Funen and the Isles, from Schleswig-Holstein and the Oder region.

The Single Grave Culture of Denmark is a phase of the Cord-marked Ware Culture of Europe. The Cord-marked Ware Culture was one of the complex of living patterns shared by the Battle-Axe peoples spreading at this time over all Europe. Scholars are not agreed as to its origin.

Some authors consider the culture native to Scandinavia and northern Germany (Schwantes, 1959:204; Åberg, 1918), but most investigators point to southern or central Russia as its land of origin, a theory first pronounced by Childe (1926). Most authors think the Single Grave peoples were Indo-European, and an extensive drought of the steppes has been suggested as one cause of this mass emigration (Sulimirski, 1933). The Jutish phase of the Cord-marked Ware Culture, which in Denmark has been termed the Single Grave Culture, seems to have much in common with the Saxo-Thuringer group in central Germany and with the Polish Złota Culture, which in turn points to the region of present-day Kiev (Glob, 1944:216).

Typical traits of the Single Grave Culture were its cord-marked pottery with a soft S-profile, single earth graves, and elegant battle axes of polished stone. Artifact development and change are best traced in stone battle axes which usually were placed in the graves of their owners. Typological differences are more diffuse and difficult to define in the simple flintwork axes. Placing them in definite periods is impossible without correlating distinctive finds. We limit ourselves to the definitions early and late.

It is likely that the invaders assimilated the megalith-building folk; at any rate the Megalith Culture disappeared about 1800 B.C., and it was probably the population resulting from this mixture that produced the splendid Bronze Age of Denmark.

#### TERMINOLOGY OF THE CATALOG

In the preparation of the catalog, Mrs. Wallace used the terminology generally preferred by Scandinavian archaeologists. For instance, "axe" instead of the American "celt" (in Scandinavian usage, "celt" is applied to socketed celts). An exception was made in the term "blade," which is used here but not in Scandinavian terminology. Mrs. Wallace also made a distinction between "end" and "side" scrapers although Scandinavians use "flake-scraper" for both.

The "left side" of a blade is the side to the left when the blade is laid on its bulbar surface with the striking-platform down.

Measurements were made in centimeters. In this catalog, they are given always in centimeters and always indicate maximum length, width, and thickness. Parentheses enclosing a measurement figure indicate that the specimen is incomplete because of ancient or modern accident. In the case of four-sided implements the measurements are



given in the following order: length, width of broad side, width of narrow side (the lengthwise sides running at right angles to the plane of the edge), and maximum thickness of cross-section. The latter measurement is indicated by brackets.

## FLINT

Nearly all the flint of the specimens is a spotty or marbled light-grey type with varying degree and kind of patination. Some artifacts are made of dark-grey flint. Both flints are native to Denmark. In instances where a recent fracture made it possible to determine the original color of the flint as compared to later patination, it was noted as: "Marbled, grey flint. Patinated yellow-brown." Otherwise only the present color was described, followed by the word "Patinated," if there was a reason to believe there was such a condition. Some have a slight yellowish tone, some are beige or yellow-brown. Some have a very strong brown patina. In many cases small portions of white or sand-colored cortex had not been removed by the maker of the implement. Only a few specimens show evidence of having been rolled.

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## LIST OF ARTIFACTS

### MESOLITHIC

#### KLOSTERLUND

1. Arrow-point. Heavy, tanged, triangular. Triangular cross-section. Irregular striking-platform. One rib. Tang shaped by direct side-blows from the edges toward the rib. Edges unretouched except on the right side of the point where a portion about 1 cm. long has retouch. Marbled beige flint. Patinated.  $7.6 \times 2.3 \times 1.1$ . ? Klosterlund, 7500 B.C. Could be Bromme, which would push its date back to 10,000 B.C. Dr. B. Almgren





Fig. 2. Bromme- and Klosterlund-type implements. a. Bromme?: Arrow-point or point for insertion into antler axe. Klosterlund: b. Knife with side notches; c. Drill-point; d. Angle-burin; e. Core-axe.

(1962) of the University of Uppsala in a personal communication to Mrs. Wallace said he believes this to be a point for insertion in an antler axe. Fig. 2a.

2. Knife. Short, wide blade. Large, plain striking-platform. Two uneven ribs. Distal end is straight and damaged on the left side. Near the bulbar end are two side notches. Bulbar scar. Marbled light-grey flint.  $5.5 \times 2.5 \times 0.5$ . Fig. 2b.

3. Knife. Short, wide blade. Three uneven ribs and flake scars. Small, plain striking-platform. Large, flat bulb of percussion. Edges partially retouched. Both sides have indentations near the bulbar end forming small side-notches. Spotty, dark-grey flint.  $7.5 \times 2.3 \times 0.7$ . The unskilled flaking technique of this knife is typical of Klosterlund work.

4. Knife. Bulbar end. Retouched sides with side notches. The right side-notch is due to the original protruding shape of the blade. The left was done by retouching. Small, plain striking-platform. Flat bulb of percussion. Bulbar scar. Marbled, grey flint. Patinated beige. (3.5) x 2 x 0.4. This may not be Klosterlund, but we believe it is of Klosterlund type.

5. Knife. Unretouched blade made from a crudely prepared core. Small, plain striking-platform. Small, flat bulb of percussion. Several ribs. Only one rib in the distal end. Right side curved with one protuberance. Distal end straight. Translucent, grey flint, slightly patinated. Small strip of white cortex on left side. 10.0 x 2.0 x 0.5.

This specimen is too long to be of classic Klosterlund type, which runs from 5 to 8 cm. in size (Mathiassen, 1937:136). Its flaking, however, is poor and of Klosterlund standard rather than of the succeeding Early Ertebølle Culture. The flaking technique was the relevant factor in placing this knife in Klosterlund.

6. Side-burin. Broken. Small piece in middle missing. Unretouched blade. Two ribs. Small striking-platform. Small, flat bulb of percussion. Bulbar scar. Two burin blows, one oblique, one transverse, the latter not very successful and later secondarily trimmed. Translucent, grey flint. (9) x 2.2 x 0.8. This burin could belong to the Ertebølle Culture.

7. Angle-burin. Small, unretouched blade. One uneven rib, forking toward the bulbar end. Large, plain striking-platform. Small, thick bulb of percussion. Irregular flake scars. Light-grey flint, translucent near edges. 7.0 x 2.0 x 0.4. Fig. 2d.

8. Blade. Fragment. Executed in same technique as No. 5. Fine retouch along one edge. Translucent, dark-grey flint. (3.0) x 3.0 x 0.5.

9. Drill point. Obliquely cut to a point. One rib. Bulbar end removed. Retouch along all edges. Probably has been hafted. Grey flint. Patinated dark-grey-brown. Rolled. 6.0 x 1.5 x 0.4. Fig. 2c.

10. Core-axe. Two-sided. Long, narrow, plain striking-platform on the butt. The edge, which probably was never very sharp, has been damaged, possibly by usage. Dark-grey flint, patinated, dark-grey-brown with some sand-colored patination over the white cortex on its sides. 11.0 x 4.5 x 2.2. Fig. 2c, 7a.

11. Bone tool. Pointed. Hollow at the base with a fastening-groove 1.5 cm. from base. Slightly curved, 12 cm. long. Aside from the fastening-groove, it much resembles the bone awls that were common in this period and for a long time thereafter.

#### EARLY ERTEBØLLE

The following artifacts were assigned to the Ertebølle Culture because of their size. The average length of the flake knives and scrapers is 9.88 cm., whereas Gudenaa knives and scrapers average about 7 cm. (Mathiassen, 1937: 77). Some of the specimens have much in common with Gudenaa forms, however, and it must be kept in mind that their assignment to the Ertebølle Culture is based on size alone.

12. Lot of shells:
- a. *Aporrhais*
  - b. *Cardium edule*
  - c. *Nerita*
  - d. *Mytilus edulis*
  - e. *Littorina littorea* (with *Serpula*)
  - f. *Oliva*.

The shells are all maritime. It is significant that the lot includes *Littorina*. This form did not appear in Scandinavia before 5000 B. C. when the Baltic once more became a salt-water sea (cf. Ekman, 1953:127).

13. Knife. Long, elegant, curved blade. Single-ribbed. Tapers to a point in the distal end. Slightly tapered in the bulbar end. Small, faceted striking-platform. Small, thick bulb of percussion. Bulbar scar. Both edges sharp and unretouched, but have a few indentations, possibly because of use. Some white cortex on right side of the point. Marbled, grey flint. Patinated grey-beige. 14.5 x 2.0 x 1.0. Fig. 3a.

14. Knife. Thick, curved blade, broken in two. Double-beveled in the bulbar end, tapered to a point in the distal. Single rib in the distal end. Double ribs in the bulbar end. Retouched along all edges except for one portion on the lower right side where the white cortex was not removed. No striking-platform. Bulb of percussion removed by a light blow. Lateral flaking in the distal end directed from rib toward the edges. Marbled, grey flint. Patinated beige. Rolled. 15.0 x 2.5 x 0.9.

15. Knife. Bulbar end broken off in antiquity. Thick, single-ribbed, curved blade. Retouched edges. Some white cortex on left side. Spotty, dark-grey flint. (6.5) x 1.5 x 0.9.

16. Blade. Distal-end piece. Single rib. Pointed. Retouched along the edges. Resembles No. 15 in technique of manufacture. White cortex on the right side. Grey flint. Patinated beige. Rolled. (5) x 1.5 x 0.8.

17. Knife. Large, curved blade. Broken in half. Several ribs. Slightly tapered at one end. The bulbar end cut or broken straight off. Both edges retouched. Trapezoidal cross-section. Small streak of white cortex on the right edge. Marbled, grey flint. Patinated yellowish-beige. 12.0 x 2.5 x 0.5.

18. Knife. Slightly curved, double-ribbed blade. Small, plain striking-platform. Flat, wide bulb of percussion. Distal point broken off. Edges unretouched but show signs of use. Marbled, grey flint. Patinated grey-beige. 12.00 x 2.5 x 0.7.

19. Knife. Slightly curved, three-ribbed blade. Small, plain striking platform. Prominent bulb of percussion. Distal end broken off. Edges



Fig. 3. Early Ertebølle-type flake implements. a,b,c,d,e,f. Knives; g. Concave end-scraper.



unretouched. Left edge has two rather deep fractures. Spotty, dark-grey flint. Patinated grey-beige. (12.0) x 2.5 x 1.0.

20. Knife. Distal end of knife. Strongly curved, single-ribbed blade. Fine retouch on edges. Beige flint. Patinated yellow-brown. Rolled. (7.5) x 1.5 x 0.6.

21. Knife. Curved blade. Distal end cut to a sharp point. One rib in distal end. Two ribs in body of blade. Plain striking-platform. Flat bulb of percussion. Retouch on both edges. Marbled, light-grey flint. Patinated grey-beige. Slightly rolled. 13.0 x 2.5 x 1.1. Fig. 3c.

22. Knife. Curved blade. Single rib in distal end. Two ribs forking to three in body of blade. Several irregular, deep flake scars. Tapered in distal end, the point of which was broken off in antiquity. The bulbar end also broken off in antiquity. Thick ripple marks. Edges slightly worn and notched from use. Left edge beveled in the distal end; originally the beveling made a point. Light-grey flint. Slightly patinated. (12.0) x 2.5 x 0.9.

23. Knife. Curved, uneven blade. Single rib. Two deep, lateral flake scars on left side of rib. Small, plain striking-platform. Large, flat bulb of percussion. Distal end broken off. Edges sharp and show signs of use. Left edge partially retouched. Marbled, light-grey flint. Patinated grey-beige. (7.5) x 2.0 x 0.8.

24. Knife. Strongly (in one end steeply) curved blade. Very small, faceted striking-platform. Very small, flat bulb of percussion. Single rib in distal end. Several ribs in body of knife. Distal end steeply curved, ends in a sharp point that was broken off, either by accident or intent. Spotty, grey flint. Patinated to a yellow tone. Portion of white-yellowish cortex on left edge. Brown patina which partially overlaps the white cortex and is scattered all over the bulbar surface. 10.5 x 2.0 x 0.8.

25. Knife. Distal-end piece of blade of the same type as No. 24. Multi-ribbed. Steeply curved. Cut off and trimmed to a perforator point. Spotty, dark-grey flint. Small portion of brown cortex on surface. (4.5) x 1.5 x 0.9.

26. Knife. Blade steeply curved in distal end. Two lengthwise ribs. Steep, lateral scars to right of right rib. Small, plain striking-platform. Small, flat bulb of percussion. Retouch along all edges. Indented from use. Tapered in bulbar end. At distal end beveled and curved. Distal end finished with sharp point suggesting this was a multi-purpose tool.



Spotty, dark-grey flint. Patinated to a somewhat brownish tone. 11.5 x 2.0 x 1.0. Fig. 3b.

27. Knife. Resembles No. 24 but is wider. Several lateral scars along upper part of right edge. Multi-ribbed. Portions of edges retouched. Small, faceted striking-platform. Small, flat bulb of percussion. Same characteristic perforator-like point as No. 24. In No. 27 there was no secondary trimming and the point developed because of the shape of the core. Small portions of white cortex on the left side of the distal end. Spotty, dark-grey flint. Patinated. 12.5 x 2.8 x 0.8.

28. Knife. Curved blade. Multi-ribbed. Small, plain striking-platform. Very small bulb of percussion. Retouch on all sides. Distal end beveled to a point. Spotty, grey flint. Patinated beige. Slightly rolled. 10.5 x 1.8 x 0.7.

29. Knife. Curved blade. Double-ribbed. Two-faceted striking-platform. Flat bulb of percussion. Bulbar scar. Tapered to point in distal end. Edges not retouched but show signs of use. Spotty, grey flint, translucent toward edges. 9.5 x 1.8 x 0.8.

30. Knife. Curved blade. Single rib in distal end. Rib forks to double ribs in bulbar end (for hafting?). Plain striking-platform. Flat bulb of percussion. Distal end is a sharp, curved point with white cortex on the left side. Sharp edges. Partly retouched. Indented from use. Dark-grey flint, translucent toward edges. 8.2 x 2.5 x 0.7.

31. Knife. Distal end of long, rather thick, heavy blade. Ends in a sharp, curved point whose tip has been broken off. Single rib in the very distal end, otherwise, double. White cortex along left side, fine trimming on other. Dark-grey flint. (5.5 x 1.5 x 0.9.)

32. Knife. Short, curved, thin blade. Double-ribbed. Retouched to a point with trimming along both edges. Small, plain striking-platform. Hardly any bulb of percussion. Bulbar scar. White cortex on right side. Edge sharp with fine retouch. Dark-grey flint. Slightly patinated to a brownish tone. Rolled. 8.2 x 1.7 x 0.6.

33. Knife. Bulbar fragment of single-ribbed blade. Striking-platform damaged. Small, thick bulb of percussion. Retouch on left edge. Spotty, grey flint. Patinated brown. (8.0) x 2.5 x 0.7.

34. Knife. Curved blade. Two ribs, close together. Beveled in distal end. Small, plain striking-platform. Hardly any bulb of percussion.

Bulbar end thinned by light blows from striking platform on dorsal side. Thinned area about 1.1 long, 0.4 thick, as compared to 0.6 on rest of flake. Edges not retouched but slightly chipped by usage. Spotty, grey flint. Patinated, intense brown. 10.5 x 2.0 x 0.6.

35. Knife. Thin blade. Two ribs. Tapered to a point in distal end. Small, plain striking-platform. Hardly any bulb of percussion. Bulbar scar. Fluting in bulbar end. Both edges sharp and retouched. Translucent, grey flint. Slightly patinated grey-beige. Slightly rolled. 10.0 x 1.6 x 0.4.

36. Knife. Thin blade. Small, plain striking-platform. Hardly any bulb of percussion. Blade broken off in distal end. Single rib, in one place forking to two. Fluting in bulbar end. Grey flint. Patinated grey-beige. 10.5 x 2.0 x 0.4.

37. Knife. Thin, slightly curved blade. One rib. Small, plain striking-platform. Distal end broken off in antiquity. Fluting in bulbar end. Both edges retouched. Grey flint, translucent toward edges. Patinated grey-beige. (8.5) x 2 x 0.6.

38. Blade-tool. Distal fragment. One rib. Retouched. Grey flint. Patinated beige. Rolled. (2.5) x 1.8 x 0.4.

39. Knife. Thin, slightly curved blade. One rib. No striking-platform. Flat bulb of percussion. Unretouched. Sharp edges show signs of use. Distal end broken in antiquity. Blade broken in two. Light-grey flint. Patinated to a darker grey. (10.0) x 1.7 x 0.5.

40. Knife. Thin blade. One rib in distal end. Three ribs in bulbar end, which was cut off in antiquity. Distal end is beveled. Retouched edges. White cortex on right edge. Spotty, grey flint. Patinated beige and grey. Rolled. (7.5) x 1.5 x 0.4.

41. Knife. Small, curved blade. One rib. Small, plain striking-platform. Small, thick bulb of percussion. Distal end broken off. Edges retouched and worn. Spotty, grey flint. Patinated beige and grey. Slightly rolled. (7.0) x 1.8 x 0.6.

42. Knife. Small, curved blade. Flared in bulbar end. Distal end broken off in antiquity. Long, narrow, finely faceted striking-platform. Thick bulb of percussion. Single rib forking toward striking platform. Edges sharp and unretouched but show some signs of use. Dark-grey flint, translucent toward edges. (6.5) x 2.5 x 0.8.

43. Knife. Elongated blade, wide in bulbar, tapered at distal end. Slightly curved. Beveled to a point at distal end. Single rib. Small, plain striking-platform. Flat, wide bulb of percussion. Bulbar scar. Bulbar end thinned with light blows from the striking platform on dorsal side. Thinned area 1.5 long, 0.5 thick. Sharp, unretouched edges which show signs of use. Broken into three pieces. Small strip of white cortex on right side. Light-grey flint.  $8.5 \times 2.6 \times 0.7$ .

44. Knife. Distal-end piece. Extremely thin. Slightly curved blade. Several ribs. Blade cut off straight at distal end. Sharp, unretouched edges. Left edge shows signs of use. Grey flint. Patinated, intense brown.  $6.0 \times 1.8 \times 0.3$ .

45. Knife. Thin blade. Two ribs. Small striking-platform. Small, thick bulb of percussion. Distal end broken off in antiquity. Sharp edges, unretouched. Both show signs of use. Small strip of white cortex on left side. Dark, spotty grey flint. Slightly patinated. Slightly rolled.  $(6.5) \times 1.5 \times 0.4$ .

46. Knife. Distal-end piece. Very thin blade. Straight. Two ribs. Cut off more or less straight at distal end. Razor-sharp edges. Right edge slightly damaged. Small portion of white cortex on right edge. Light-grey marbled flint. Patinated, yellowish beige.  $(5.5) \times 2.0 \times 0.3$ .

47. Blade. Retouched. Very thin. Two ribs. Small, plain striking-platform. Small, thick bulb of percussion. Distal end broken off in antiquity. Blade has recent breakage in middle. Fine indentations on both edges, those on the right certainly due to secondary trimming. Light-grey, marbled flint.  $(7.0) \times 2.0 \times 0.3$ .

48. Knife (saw?). Small, curved blade, somewhat irregular. Small, plain striking-platform. Small, flat bulb of percussion. One rib, at distal end. Several flake scars in bulbar end. Blade pointed at distal end. Edges retouched. Right edge has saw-like indentations which may be accidental. Grey, marbled flint, translucent. Patinated brown. Slightly rolled.  $7.2 \times 1.2 \times 0.3$ .

49. Knife. Small, slightly curved, very thin, lanceolate blade. Small, faceted striking-platform. Hardly any bulb of percussion. One rib. Sharp, unretouched edges with some fine indentations. Grey flint, translucent. Patinated dark grey-brown.  $7.5 \times 1.5 \times 0.4$ .

50. Knife (?). Distal fragment of a leaf-thin, somewhat tapered blade. Both edges sharp, the left with fine retouch. Spotty, light-grey flint, Patinated, dark grey-brown.  $(3.0) \times 1.5 \times 0.3$ .

51. Knife. Wide blade, broken in two places in recent times. Distal end missing. Small, plain striking-platform. Flat bulb of percussion. Two ribs. Bulbar scar. Both edges sharp and show signs of use. Left edge possibly retouched. Marbled, grey flint. Patinated grey-brown. (9.0) x 2.5 x 0.6.

52. Knife. Heavy curved blade. Broken. Distal end and middle pieces missing. Small, plain striking-platform. Flat bulb of percussion. Two ribs, forking to three. Both edges sharp. Indentation of right one probably due to secondary trimming. Marbled, grey flint. Patinated yellowish. Rolled. (10.0) x 2.5 x 0.7.

53. Knife. Slightly curved. Broken in two places. Distal end missing. No striking-platform. Small, thick bulb of percussion. Bulbar end pointed. Two ribs, merging in bulbar end. Edges retouched. Marbled, grey flint. Patinated grey-beige. Rolled. (9.0) x 1.8 x 0.6.

54. Knife (side-scraper ?). Bulbar-end piece. Striking-platform damaged. Small, thick bulb of percussion, clearly limited. Two ribs, forking to three toward striking-platform. Retouch on all sides. White cortex on left side. Spotty, dark-grey flint. (4.5) x 2.0 x 0.6.

55. Knife. Thin, curved blade, broken in two. Bulbar end damaged. Two ribs. Distal end double-beveled and very thin, with fine retouch. Edges sharp and unretouched. Left edge shows slight use. Marbled, light-grey flint. Patinated beige. 11.5 x 2.0 x 0.5.

56. Knife. Slightly curved blade. Minute, plain striking-platform. Small, flat bulb of percussion. Two ribs, one forking in distal end, which is beveled and very sharp. Some fluting in bulbar end. Sharp, unretouched edges, except for a small portion of left edge near the bulbar end which has retouch. Marbled, light-grey flint. Patinated, light-grey-beige. 10.2 x 1.8 x 0.6.

57. Knife. Slightly curved blade of same type as No. 33. Distal end broken off in recent times. Small, plain striking-platform. Flat, wide bulb of percussion. Bulbar scar. Two ribs. Edges sharp, unretouched, used. Marbled, light-grey flint. Patinated beige. (8.9) x 2.0 x 0.7.

58. Knife (side-scraper ?). Long, curved blade. Small, plain striking-platform. Flat, wide bulb of percussion. Two ribs, close together. Retouched edges. Distal end broken off in antiquity, possibly intentionally, so it could be used as a transverse burin, something the chips off this surface might indicate. Grey flint. Patinated, dark beige. Slightly rolled. (11.0) x 2.3 x 0.6. Fig. 3f.



59. Knife. Thin, almost straight blade. Broken in two; some pieces missing from middle. Small, plain striking-platform. Small, thick bulb of percussion. Two ribs. Three ribs in distal end. Bulbar scar. Parallel sides. Both edges retouched and/or worn. Distal end cut off squarely. Dark-grey flint. Patinated thickly in a yellowish tone. Heavily rolled. 10.5 x 1.5 x 0.5.

60. Knife. Long, backed blade. Trapezoidal cross-section. Small, plain striking platform. Small, thick bulb of percussion. One rib. Two ribs in bulbar end, forming a concave "finger-rest." Bulbar scar. Blade broken into three pieces. Distal end broken off in antiquity. White cortex along blunt edge. Dark-grey flint. (12.5) x 1.5 x 0.7. Fig. 3e.

61. Knife. Curved, twisted blade. Striking-platform damaged. Flat, wide bulb of percussion. One rib, that forks toward both bulbar and distal ends. Retouch along all edges. Slightly convex distal end. White cortex on right side. Marbled, grey flint. Slightly patinated grey-beige. Rolled. 10.5 x 1.8 x 0.8.

62. Knife. Strongly twisted, curved blade. Struck from a core similar to that used to make No. 61. Large, plain striking-platform. Small, flat bulb of percussion. One rib, which forks toward the distal end. Distal end wide, thin, with a concave indentation. Retouch on all edges except on white cortex along right edge, which is patinated sand color. Dark-grey, translucent flint 7.5 x 1.7 x 0.6. Fig. 4b.

63. Knife. Small, flat, backed blade. Large, plain striking-platform set at an angle with the blade. Thick bulb of percussion. One rib, that forks toward the distal end. Distal end very thin, cut off straight. Projection to the left as a result of the large bulb of percussion. White cortex along right side. Dark-grey flint. 7.5 x 1.7 x 0.4.

64. Knife. Bulbar-end piece of backed blade. Trapezoidal cross-section. Large, plain striking-platform. Small, thick bulb of percussion. White cortex on left side. Dark-grey flint. 2.6 x 1.7 x 0.4.

65. Knife. Backed blade. Broken. Distal end missing. Small, plain striking-platform. Flat bulb of percussion. Two ribs. Left edge sharp and unevenly indented but shows no signs of deliberate retouching. White cortex along the blunt right edge. Dark-grey flint. (9.0) x 2.2 x 0.5.

66. Knife. Short, straight, wide blade. Small, plain striking-platform. Three uneven ribs. Bulbar end pointed. Distal end straight with a





Fig. 4. Early Ertebølle-type flake implements. a. Side-scraper; b. Knife; c. Convex end-scraper; d. Straight end-scraper; e. Saw.

corner broken off in antiquity. Side edges sharp and unretouched. This blade was probably hafted; strain on hafting point could easily produce the corner-break mentioned. Marbled, spotty, grey flint. Patinated yellow-brown.  $8.5 \times 2.8 \times 0.8$ .

67. Knife. Long, pointed. Very thin, curved blade. Minute, plain striking-platform in pointed end. Hardly any bulb of percussion. Two ribs. One at the bulb of percussion. Distal end cut off straight, slightly damaged. Edges sharp and indented, probably from use. Marbled, light-grey flint. Patinated unevenly, beige. Rolled.  $12.5 \times 2.5 \times 0.4$ . Fig. 3d.

68. Knife. Lanceolate, thin, slightly curved blade. Struck from a spindle-shaped core. No striking-platform. The very small bulb of percussion removed by pressure retouch. Edges retouched. Shape and retouch indicate possibility of hafting. White cortex along one side. Light-grey flint. Patinated beige. Rolled.  $10.5 \times 2.0 \times 0.6$ .

69. Knife or saw. Almost semi-lunate. Large, plain striking-platform. Large bulb of percussion. Bulbar scar. Distal end trimmed to sharp point. Several flake scars on left side of rib. Both edges retouched. Point well used. Marbled, grey flint. Patinated yellow-brown. Slightly rolled.  $8.0 \times 2.5 \times 0.8$ .

70. End-scraper. Concave. Short, curved blade. Small, plain striking-platform. One rib, eventually becoming many ribs in bulbar end. Several flake scars on the right side. Edges retouched. Distal end retouched into a concave form. Portion of white cortex on dorsal surface. Marbled, grey flint. Patinated yellow. Rolled.  $7.0 \times 2.0 \times 0.7$ . Fig. 3g. This type of endscraper is typical for the Ertebølle culture.

71. End-scraper, Oblique. Short, curved, irregular blade. Small, faceted striking-platform. Small, thick bulb of percussion. The flaking is slightly diagonal. One short median rib in distal end. Two diagonal ribs on the rest of the implement. Tool thinner in bulbar end due to a light blow before the flake was detached from the core, leaving a small, triangular scar, 0.9 long. Thickness of flake here, 0.4. All edges retouched. Distal end beveled. Much the same technique of manufacture as No. 69. Marbled, grey flint. Patinated yellow-brown. Slightly rolled.  $7.0 \times 1.7 \times 0.7$ .

72. End-scraper. Convex. Small, thick blade tapered in bulbar end. Plain striking-platform. Small, thick bulb of percussion. Two ribs. Two small secondary scars on dorsal side, from blows struck from a point left of striking platform, make a "thumb rest." 2.6 long. Flake 0.4 thick here. Marbled, grey flint. Patinated grey-brown. Rolled.  $7.0 \times 2.5 \times 0.8$ . Fig. 4c.

73. End-scraper. Small, wide, backed blade. Small, plain striking-platform. Very small, flat bulb of percussion. Right side of blade thin. No retouch. Worn. Left side is thick, with white cortex. Trapezoidal in cross-section. Distal end is wide and has a concave fracture. Spotty, grey flint. Rolled.  $8.0 \times 2.5 \times 0.8$ .

74. End-scraper. Convex. Short, wide. Slightly curved blade with large, plain striking-platform. Small, thick bulb of percussion. Bulbar scar. One rib. Some fluting in bulbar end. Distal end convex and almost oblique on its left side. All edges retouched. Strip of white cortex on left side. Marbled, grey flint, translucent toward the edges. Patinated grey-brown.  $5.5 \times 2.0 \times 0.7$ . In addition to its function as an end-scraper, this tool could well have been used as a side-scraper.

75. Straight end-scrapers. Heavy, slightly curved, wide blade. Triangular large, plain striking-platform. Extremely flat bulb of percussion. One rib forked toward distal end. Concave hinge-fracture scar that could serve as a "thumb rest," in bulbar end, on dorsal side, from blow struck from striking-platform. 2.3 long, 0.3 deep. All sides retouched. Spotty, grey flint. Patinated yellow. Rolled.  $9.0 \times 2.5 \times 0.9$ . Fig. 4d.

76. End-scrapers. Bulbar-end-piece of blade of same type as No. 75; at least it was struck from a similarly fashioned core. Large, plain, triangular striking-platform. Flat, wide bulb of percussion. Bulbar scar. Retouched edges. Grey flint. Patinated grey-beige. Rolled.  $(4.5) \times 2.5 \times 1.0$ .

77. End-scrapers. Oblique. Short, slightly curved, fairly wide blade. Struck from a core similar to that of No. 75, but the striking-platform is faceted. One shallow, narrow scar, 4.3 long, along upper part of left edge, on bulbar side. One rib forked toward both distal and bulbar ends. All sides retouched. The flake has been broken off below the bulb of percussion, and the broken edge retouched. Spotty, grey flint. Patinated yellow.  $7.5 \times 2.0 \times 0.9$ .

78. End-scrapers. Straight, short, wide blade. One rib. Small, plain striking-platform. Large, wide bulb of percussion. Left corner of straight distal end broken off in recent times. Both edges fairly sharp. Right edge retouched. Distal end may have been retouched on bulbar side although the chipping may be due only to use. Spotty, grey flint. Patinated yellow-brown.  $8.0 \times 3.0 \times 0.9$ . Scrapers of this type but smaller, averaging only about 5 cm. long, are typical implements of the inland Gudena culture. (Mathiassen, 1937: 77, 83.)

79. End-scrapers. Oblique. Blade with parallel sides, quite straight. Sides retouched. Large, plain striking-platform. Two ribs. Bulbar scar. Distal end beveled to sharp point. Point could have been used for perforating. Light-grey flint. Patinated beige. Rolled.  $9.0 \times 2.0 \times 0.6$ .

80. End-scrapers. Double beveled. Slightly curved, thin blade. Minute, plain striking-platform. Small, thick bulb of percussion. Two ribs. Distal end double-beveled to a point, steeply retouched. Sharp edges, unretouched but used. Long, narrow hinge-fracture scars along right edge. Struck from the striking-platform on dorsal side. This area 3.7 long, 0.1 deep. Marbled, light-grey flint. Patinated.  $10.5 \times 2.5 \times 0.5$ .

81. End-scraper. Straight, thin, curved blade. Straight distal end. Minute, plain striking-platform. Thick bulb of percussion. Retouched edges. Steep retouch on distal end. One rib. Marbled, grey flint. Patinated beige. Rolled.  $9.0 \times 2.0 \times 0.5$ .

82. Side or end-scraper. Curved, thin, wide blade. Minute, plain striking-platform. Very flat bulb of percussion. Two ribs, forking to four. All sides retouched. Tapered, to about 1 cm. from distal end where it becomes wider again. Marbled, grey flint. Patinated yellowish. Heavily rolled.  $10.5 \times 2.3 \times 0.5$ .

83. Side-scraper. Heavy, irregular blade. Minute, striking-platform. Small, thick bulb of percussion. Two wavy ribs. Distal end broken off. All edges retouched. Concave fracture on left side near bulbar end was probably intentional. Direct hammering evidence, stone on stone, in bulbar end. The intent was removal of small lateral flakes to left of rib. Blows directed from rib. Strip of white cortex on left edge. Spotty, grey flint. Patinated dark.  $(10.0) \times 2.0 \times 0.8$ .

84. Distal end-piece of blade. One rib. Edges not retouched. Made in same technique as No. 83 with flakes detached laterally from the rib. Dark grey flint, translucent at edges. Patinated brownish.  $(4.0) \times 1.5 \times 0.7$ .

85. Side-scraper. Backed. Large, heavy blade. Made by same technique as used for manufacture of No. 74. Two ribs. Two lateral flake scars on left side of ribs. Convex distal end. Edges retouched. One side probably deliberately blunted. Blade damaged in bulbar end, now broken in two. Portions of white cortex on surface along both left and right edges. On right side, blade not retouched where there is cortex. Blunting retouch on continuation of edge where cortex stops. Dark-grey flint. Patinated grey-brown.  $12.0 \times 2.6 \times 0.7$ . Fig. 4a.

86. Side-scraper. In type, comparable to No. 85. Small, plain striking-platform. Small bulb of percussion. Two ribs. Several longitudinal and lateral scars along left side of ribs. Lateral scars are from small blows struck from the rib toward edges. Edges retouched. Distal end tapered to a point broken off at the extremity. Spotty, dark-grey flint. Rolled.  $10.5 \times 2.5 \times 0.9$ .

87. Side-scraper. Heavy blade. Pointed at both ends. Striking-platform removed by an oblique, short burin blow on right side. Left side retouched to meet this in a wide point. Wide, flat bulb of percussion.



Left side and distal end very thin. Convex protrusions on left side. Retouched edges. Broken in two. White cortex along the thick right side. Spotty, dark-grey flint.  $12.0 \times 2.3 \times 0.8$ .

88. Saw. Slightly curved, lanceolate blade. Minute, plain striking-platform. Very small bulb of percussion. One rib. Some fluting in bulbar end. Even indentations along edges. Broken in two. Some white cortex in distal end. Grey flint. Patinated brown.  $9.5 \times 1.7 \times 0.6$ .

89. Saw. Slightly curved, narrow blade. Minute, plain striking-platform. Small, flat bulb of percussion. Small bulbar scar. Blade cut off straight at distal end. Edges retouched. Even indentations. Dark-grey flint. Patinated brown. Rolled.  $8.5 \times 1.5 \times 0.6$ . Fig. 4e.

90. Saw. Slightly curved, narrow blade. No striking platform. Small, flat bulb of percussion. Minute bulbar scar. Two ribs close together. Edges retouched. Even indentations. Broken in two places. Distal end missing. Spotty, grey flint. Patinated brown. Rolled.  $(7.5) \times 1.5 \times 0.5$ .

91. Saw. Curved blade. No striking platform. No bulb of percussion. One rib from which flakes have been removed laterally on the left side. Edges retouched. Even indentations. Broken in two. Grey flint. Patinated brown. Rolled.  $8.0 \times 1.5 \times 0.8$ .

92. Bulbar end-piece of small saw. Slightly curved, narrow blade. Minute striking-platform. Very small bulb of percussion. Edges retouched. One rib, forked in bulbar end. Spotty, light-grey flint. Patinated beige. Rolled.  $(5.0) \times 1.5 \times 0.5$ .

93. Saw. Very thin, slightly curved blade. Minute, plain striking-platform. Hardly any bulb of percussion. Two ribs. Edges retouched. Small, even indentations. Technique of manufacture of this saw much like that used to make Nos. 47 and 94. Grey flint, translucent at edges. Patinated brown.  $9.5 \times 1.8 \times 0.4$ .

94. Transverse burin or knife. Extremely thin. Striking-platform has been struck off. Flat, wide bulb of percussion. Small blade with sharp, retouched edges. One rib forked in distal end. In material and manufacturing technique much like Nos. 47 and 93. Light-grey-beige flint.  $8.0 \times 2.0 \times 0.4$ . Fig. 5a.

95. Side-burin. Large, two-faceted striking-platform. Flat, wide bulb of percussion. Uneven, slightly curved blade. Edges retouched.



One rib. Burin edge on upper part of left edge. Strip of white cortex on right side. Right side of bulbar end thinned by light blows from right corner of the striking-platform on dorsal side. Thinned area 1.3 long, 0.6 thick. Marbled, grey flint. Patinated yellowish. Rolled. 10.0 x 2.0 x 0.7. Fig. 5b.

96. Double angle-burin. Minute striking-platform. Hardly any bulb of percussion. Parallel, retouched edges. Two oblique burin blows in distal end. One rib in main body. Three ribs toward striking-platform. The triangular scars they form are the result of thinning blows from the striking-platform on the dorsal side. Thinned area 3 long. Blade, 0.4 thick in this end. Portion of white cortex along left side, making a "back." Blunting retouch on continuation of edge. Marbled, grey flint. Rolled. Patinated brown. 9.5 x 2.5 x 1.1. Fig. 5c.



Fig. 5. Early Ertebølle-type flake implements. a. Burin-knife; b. Side-burin; c. Double angle-burin; d. Straight end-scraper; e. Saw.

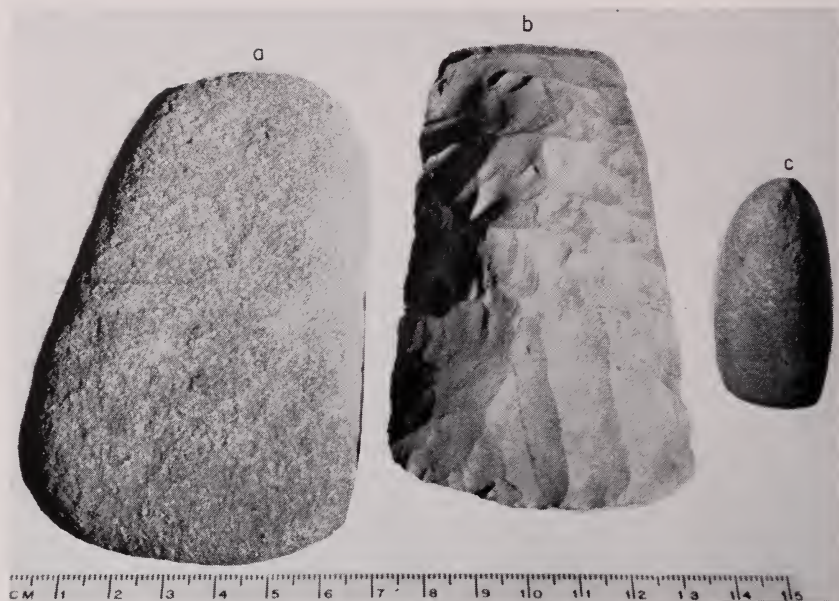


Fig. 6. Late Ertebølle. a. Greenstone axe; b. "Specialized" core-axe; c. "Round" axe.

97. Borer. Fashioned to a strong point at bulbar end. No striking-platform. Small bulb of percussion, most of which was removed. Thick at distal end. Edges retouched. White cortex on distal end. Spotty, grey flint. Patinated brown.  $9.5 \times 2.5 \times 1.1$ . Fig. 5d.

98. Drill-point and saw. Triangular. Large, plain striking-platform. Bulb of percussion was removed. Edges retouched. Bulbar end somewhat thinned by fine retouch on dorsal side. Spotty, grey flint. Patinated brown. Slightly rolled.  $7.5 \times 2.0 \times 0.7$ . Fig. 5f.

99. Side-scraper or burin. Small, short implement. Pointed oval cross-section. Trimmed to a tang at one end. Shaped as a burin at other end. No striking-platform. The point of impact was along one side. Both surfaces appear to be bulbar with ripple marks and lower parts of negatives of bulbs of percussion. Spotty, grey flint.  $6.0 \times 2.0 \times 0.9$ . Fig. 24e.

100. Flake. Triangular. Very thin. Slightly curved. Minute, thin striking-platform constitutes top of triangle. Minute bulb of percussion. One wavy rib. Bulbar scar. No retouch. Edges indented from use. Fracture in left corner. Marbled, grey flint.  $4.5 \times 3.0 \times 0.4$ .

## NEOLITHIC

## LATE ERTEBØLLE

101. Axe. Core-axe. Of the so-called "specialized type" considered typical of Late Ertebølle. Executed in a skilled core-technique in which the cutting-edge has been improved by longitudinal cutting, making it very sharp. Very regular specimen. Never used. Dull, beige flint. Patinated. 13.5 x 5.5 x 3.0. Figs. 6b, 7b.

102. Axe. Miniature. So-called "round type." Very regular, well ground, polished. Butt heavy and somewhat pointed. Almost straight edge. Four distinct sides in lower half. Greenstone. 6.5 x 2.6 x 1.4. Figs. 6c, 7c.



Fig. 7. Profiles of axes. a. Klosterlund core-axe; b. "Specialized" core-axe; c. "Round" axe; d. Greenstone axe.

103. Axe. Butt thick, straight. Edge slightly convex, somewhat slanted, very dull. Four sides. Pecking and grinding technique poor. Greenstone. 11.5 x 6.5 x 3.0. Dr. Almgren (1962) believes this also might be considered a thick-butted axe of Neolithic-E times. Figs. 6a, 7d.

#### FUNNEL-NECKED BEAKER CULTURE A

104. Point-butted axe. Two-sided. Very regular. Unground. Unfinished. Butt tapered and narrow. Edge convex with rounded corners giving smooth transition from edge to sides. Never used. Some white cortex on one of the broad sides. Spotty dark-grey flint. 16.5 x 4.0 x 2.0. Fig. 9d; Fig. 11a. Point-butted, two-sided flint axes were the first flint axes suitable for tree-felling introduced into Denmark.

#### FUNNEL-NECKED BEAKER CULTURE B

The classification of axes Nos. 105 through 146 follows Becker (1957). They are *Thin-butted axes* and were used throughout the C-period as well as the B. They are known as the "*Old Type*." They are four-sided, and ground and polished on all four sides. Both broad and narrow sides are somewhat convex. Hafted specimens found prove this kind of axe was hafted with the butt protruding from the handle and that the axe was usually inserted at a slight angle with the handle. Consequently, the butts are often beveled to make them parallel with the handle, although they are then at an angle with the edges of the axes.

105. Unfinished. Slightly ground on one broad side. Butt beveled. Edge convex. Spotty, grey flint. 19.0 x 8.0 x 2.0 x [3.8]. Fig. 8a.

106. Very regular. Butt convex. Edge convex. Edge worn by usage. Spotty, dull, light-beige flint. 19.0 x 7.0 x 2.5 x [3.5].

107. Unfinished. Unground. Butt convex. Edge convex. Dull, grey flint. Patinated. 16.0 x 7.0 x 2.0 x [3.8].

108. Unfinished. Unground. Slightly irregular shape. Butt convex. Edge convex. Edge somewhat slanted. Brown-grey flint. Patinated. 17.5 x 7.5 x 2.0 x [3.1].

109. Slightly bulging sides. Butt convex. Edge convex. Edge damaged in one corner. Greenstone. 17.0 x 8.0 x 2.0 x [4.3]. Fig. 8b.





Fig. 8. Funnel-necked Beaker Culture B and C. Thin-butted axes, "Old Type." a. Unfinished specimen; b. Greenstone "Old Type" axe; c. Polished on all sides.

110. Smaller. Butt convex. Edge almost straight. Worn. Spotty, black-grey flint.  $13.5 \times 5.0 \times 1.7 \times [2.7]$ . Fig. 8c; Fig. 11b.

111. Slim. Narrow sides almost straight. Butt straight. Probably was used for hammering. Edge convex, damaged in one corner. Marbled, beige flint.  $17.0 \times 5.5 \times 1.9 \times [3.0]$ .

112. Unfinished. Unground. Butt straight. Edge slightly convex, somewhat slanted. Yellow-brown flint. Patinated.  $15.5 \times 6.0 \times 1.6 \times [2.7]$ .

113. Wide blade. Butt convex. Edge convex. Edge and butt re-sharpened but not repolished. Dull, light-beige flint.  $19.5 \times 9.0 \times 3.0 \times [4.3]$ . Fig. 9d; Fig. 11a.



No. 114 is a *Point-butted axe*. Introduced in the A-period, they were used throughout the B-period and changed from two-sided to four-sided implements under the influence of the Thin-butted Axe technique. All are polished.

114. Huge. Very regular. Edge resharpened by crude chipping. Four sides. Only broad sides polished. This may mean this axe really belongs with the following period. Its size may well lead to the same conclusion. Most four-sided, point-butted axes belong to the B-period, however. Always bearing in mind that typological grounds are not entirely reliable for drawing chronological lines, since particular tool types can be manufactured in some localities long after they are out of

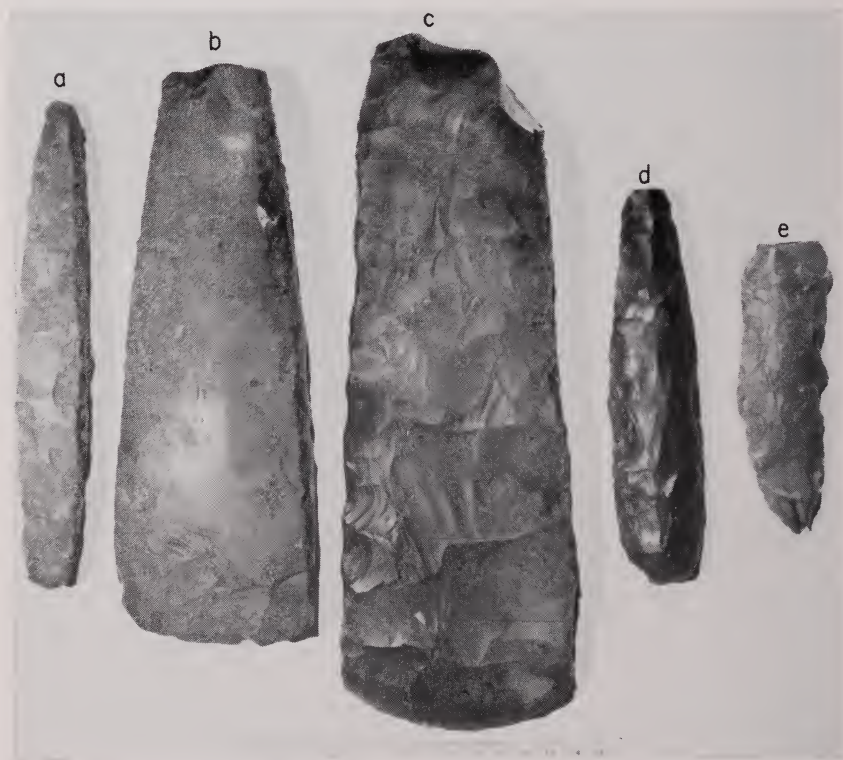


Fig. 9. Funnel-necked Beaker Culture A,B,C, and D. a. Thick-butted chisel, D; b. Point-butted four-sided axe, B or C; c. "Ceremonial" thin-butted axe, C; d. Point-butted, two-sided axe, A; e. Pointed axe or halberd, C. Size of implements is indicated by 15-cm. scale.

fashion in others, we assign this to B. Marbled, grey flint. 23.5 x 8.0 x 3.0 x [3.9]. Figs. 9b, 11d.

#### MEGALITH CULTURE—FUNNEL-NECKED BEAKER CULTURE C

114A. (See also 189) Pointed axe or heavy knife. Large, plain striking-platform. Specimen somewhat curved to one side. Crudely made. Marbled, grey flint. 12.0 x 4.0 x 1.5. Fig. 9e. The dating and use of implements such as this one have been a matter of discussion. Some believe they are late Neolithic (Björn, 1935:3-4). They have, however, been found in dolmens in association with C-Culture material (Nordman, 1927, 2:108, fig. 88), and they are generally believed to have been hafted as halberds.

Nos. 115 through 118 are *Thin-butted Axes—Old Type*. They differ from the Old Type axes of the preceding period by being longer and proportionally more slender. Ground and polished to perfect smoothness, they were the largest and technically best made flint axes ever produced. Danish axes of this type have been found in Norway and Sweden. They seem to have been traded in the form of semi-manufactures, i.e., shaped but not ground and polished. Our collection contains only unground specimens.

115. Unfinished. Unground. Butt beveled. Edge convex. White cortex on one broad side. Yellow-brown flint. Patinated. 19.0 x 7.0 x 2.0 x [3.7].

116. Unfinished. Unground. Butt convex. Edge convex. Marbled, grey-beige flint. 19.0 x 7.7 x 2.0 x [3.6].

117. Unfinished. Unground. So-called "ceremonial" type. Beautiful specimen. Slightly bulging sides. Butt convex and beveled. Edge convex. Sand-colored cortex on one broad side. Yellow-brown flint. Patinated. 24.5 x 9.0 x 1.7 x [3.3]. Axes of this kind often occur in caches in the ground. For this reason, they are interpreted by some as trade goods rather than as religious items which, according to some evidence, were usually old, well-used specimens (Brøndsted, 1957, 1:198).

118. Description as for No. 117. White cortex on butt. 27.5 x 9.0 x 2.0 x [3.5]. Figs. 9c, 11c.

#### MEGALITH CULTURE—FUNNEL-NECKED BEAKER CULTURE D

No. 119 is a *Thin-butted Axe—Blandebjerg Type*." The butt is wider



Fig. 10. Funnel-necked Beaker Culture D. Thick-butted axes, "Bundsø Type."

and thicker than in the "Old Type." The narrow sides are straight. The broad sides are convex. Only the broad sides are polished.

119. Ground and polished on all four sides but the polishing is incomplete on narrow sides. Butt beveled. Edge convex, somewhat slanted. Beige flint.  $14.0 \times 6.0 \times 2.5 \times [3.2]$ .

Nos. 120 through 129 are *Thin-bladed Axes*. They resemble Blandebjerg Type axes but are smaller and thinner.

120. Unfinished. Unground. Irregular. Butt narrow. Edge flared. Three, or rather, three and one-half sides. Attempts were made to make it four-sided but the task was abandoned. One of the narrow sides formed by a single flaking stroke, the other by retouching. One broad side is flat and partly covered with white and colored cortex.



Other broad side has a large protuberance. Edge slightly convex. Spotty, grey-brown flint. Patinated. 15.5 x 5.0 x 2.0 x [2.9].

121. As No. 120. Edge more flared on one side than the other. Four-sided except toward the edge where it has only three sides. Spotty, grey flint. 16.5 x 5.0 x 2.0 x [2.3].

122. Regular. Four-sided. Ground and polished on broad sides. Most carefully polished toward edge. Edge slightly convex. Flared, worn and damaged in one corner. Light-grey flint. 12.0 x 5.0 x 1.5 x [2.3].



Fig. 11. Funnel-necked Beaker Culture A,B,C, and D. Profiles of axes. a. Point-butt, two-sided axe, A; b. "Old type," B and C; c. "Ceremonial" axe, C; d. Point-butt, four-sided axe, B or C; e. "Bundø Type," D.



Fig. 12. Funnel-necked Beaker Culture D. Frontal view of adze and axes. a. Point-butt, two-sided adze; b,c. Thin-bladed, four-sided axes; d. Thin-bladed, two-sided axe; e. Small, thin-bladed axe.





Fig. 13. Profile view of adze and axes shown in Fig. 12. **a.** Point-butt, two-sided adze; **b,c.** Thin-bladed, four-sided axes; **d.** Thin-bladed, two-sided axe; **e.** Small, thin-bladed axe.

123. As No. 122. Almost straight edge, very worn and damaged in one corner. Light grey-beige flint. 12.0 x 5.0 x 1.5 x [2.1].

124. As No. 122. Edge less flared than that of No. 122. Profile somewhat curved. Edge almost straight. Edge worn. Light-grey flint. Patinated beige. 14.0 x 5.0 x 1.7 x [2.1].

125. Small. Four-sided. Butt narrow. Flared edge. Edge almost straight. Worn. Incompletely polished on all four sides. Light grey-beige flint. (This could be a specimen from the Single Grave Culture, perhaps late.) 8.5 x 3.5 x 1.0 x [1.4]. Figs. 12e, 13e.

126. As No. 122. Edge not flared. Edge badly damaged. Light-grey flint. Patinated beige. 12.5 x 4.5 x 1.3 x [1.7].

127. As No. 122. Butt beveled. Edge almost straight. Edge shows signs of use. Light-grey flint. Patinated beige. 12.5 x 4.5 x 1.1 x [1.7].

128. Lower part of two-sided axe. Ground and polished. Edge convex. Worn. Light-grey flint. 4.1 long to broken edge x 4.0 x 1.2. Figs. 12d, 13d. This kind of axe is not common in Denmark. It may be from early Neolithic times.

129. Long, narrow. Recently broken in two. All four sides polished. Edge slightly convex. Edge well worn. Very regular specimen. Spotty, dark-grey flint. 15.0 x 3.5 x 1.0 x [1.5]. Figs. 12c, 13c.

Nos. 130 through 132 are *Point-butted, two-sided adzes, ground in furrows*. These early adzes are all two-sided, in which respect they differ from later adzes, manufactured by the people of the Single Grave Culture, which always had four sides.

130. Damaged edge. Spotty brown flint. Patinated. 15.0 x 4.5 x 2.8. Figs. 12a, 13a.

131. Damaged edge. Spotty, yellow-brown flint. 12.0 x 4.0 x 2.0.

132. Damaged edge. Greenstone. 12.5 x 5.0 x 3.5.

In the middle Neolithic (III) manufacturing of Thick-butted axes began. Axes were made with a thick butt because of a new hafting technique in which the butt was set flush with the handle instead of protruding as it had in previous cultures. The butt was usually beveled to facilitate this hafting. Thick-butted axes are generally long and slen-

der and have a slightly flared blade. Their form was undoubtedly influenced by metal axes of bronze and copper that were produced in central Europe and to some extent exported to Denmark. Most thick-butted axes belong to the Funnel-necked Beaker-E and Single Grave Cultures. They did, however, also influence the Blandebjerg type of axe, so it, too, was made thick-butted. We call this the Bundsø Type axe. Nos. 133 - 134 are *Thick-butted axes—Bundsø Type*.

133. Butt straight. Edge convex. Ground smooth. Greenstone. 15.5 x 7.0 x 2.8 x [3.9]. Figs. 10c, 11c.

134. Butt has one corner concavely cut off. Edge convex. Broad sides polished. Incomplete polish on narrow sides. Beige flint. 12.2 x 7.0 x 3.2 x [4.7]. Fig. 10a.

135. Chisel. Four-sided. Very regular. Ground and polished toward edge. Some white cortex on butt and one side. Spotty, beige flint. 19.5 x 2.5 x 2.0. Fig. 9a.

#### MEGALITH CULTURE—FUNNEL-NECKED BEAKER CULTURE E

The earliest thick-butted axes have a rectangular cross-section at the butt. The proportions of narrow sides to broad sides at the butt lie between 3 to 4, and 2 to 4. Flared axes with such a butt are called the *Lindø Type*.

The later thick-butted axes are of the *Valby Type*. In these the cross-section is almost square. The proportions of narrow sides to broad sides at the butt lie between 4 to 4, and 3 to 4.

Nos. 136 and 137 are of the *Lindø Type*.

136. Ground and polished on broad sides. Edge convex, slanted. Edge was damaged and resharpened. Marbled, light-grey flint. 13.0 x 6.0 x 2.5 x [3.1]. Figs. 14a, 17a.

137. Ground and polished on broad sides. Edge convex, slanted. Regular. Marbled, grey flint. 12.5 x 6.0 x 3.0 x [3.2].

Nos. 138 through 146 are of *Valby Type*. Nos. 138, 139, and 140 are representative of transitional forms between *Lindø* and *Valby* types. All are four-sided. All are practically flat. Usually broad sides are ground and polished. Thick-butted axes are usually shorter than Thin-butted axes but No. 141 is an exception. The technique of execution is not as fine as that of Thin-butted axes. It is evident that utility rather

than beauty guided the hands of the flintsmiths who made Thick-butted axes.

138. Butt cut obliquely toward one of the broad sides. Edge convex. Marbled, grey flint. Patinated beige.  $13.0 \times 5.0 \times 2.4 \times [2.6]$ .

139. Written on it in ink is the name of a former owner, Severin Jensen of Thisted. Butt straight. Edge convex. Edge somewhat slanted. Marbled, grey flint. Patinated grey-beige.  $15.5 \times 7.0 \times 3.2 \times [3.9]$ .

140. Unground. Butt almost straight. Edge convex. Some white cortex on one broad side. Dull, beige flint.  $15.0 \times 4.5 \times 2.5 \times [3.0]$ .

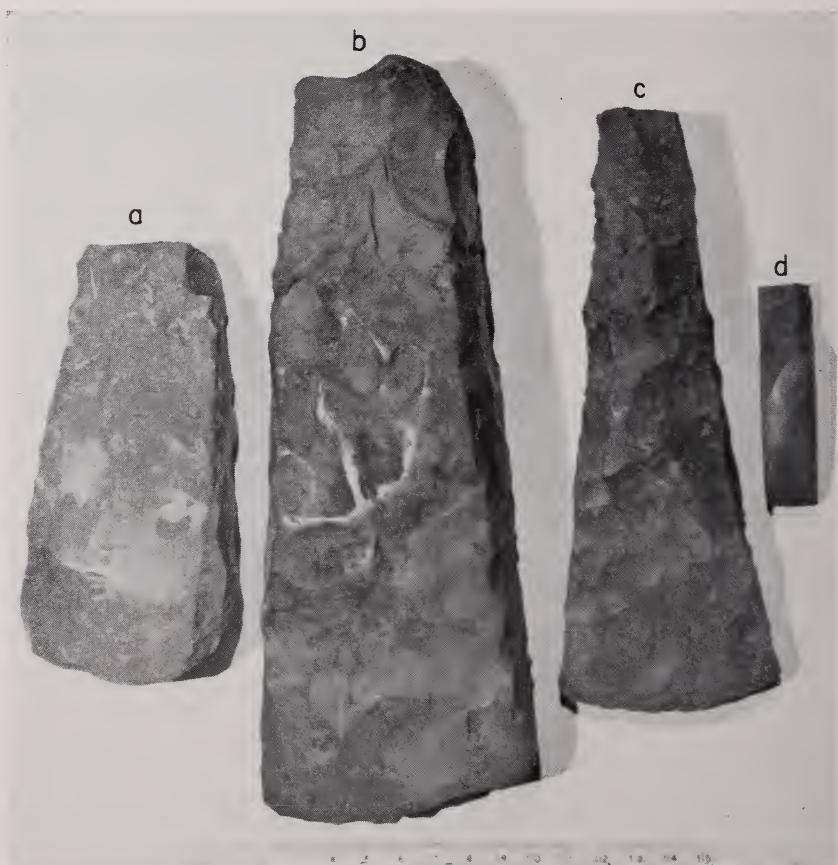


Fig. 14. Funnel-necked Beaker Culture E. a,b. Thick-butted axes, "Lindø Type"; c. Thick-butted axe, "Valby Type"; d. Thick-butted chisel.



141. Huge. Regular, beautiful. Of "ceremonial" size. Executed with the careful technique typical of Thin-butted axes. A good example of the persistence of an old tradition despite more general acceptance of a new one. Edge resharpened by crude chipping. Axe has been used as a tool. Some white cortex on butt. Marbled, light-grey flint. 25.5 x 8.0 x 4.0 x [4.8].

142. Ground. Edge flared. Regular. Spotty, dull, grey-brown flint. 17.0 x 6.0 x 2.6 x [3.0]. Figs. 14c, 17b.

143. Axe. As No. 142 but with straight edge. Dull, grey flint. 15.0 x 5.5 x 2.8 x [3.3].

144. Large. Unground. Butt irregular. Edge convex. White cortex partly covered by sand-colored cortex at butt and on broad sides. Brown flint. 21.0 x 6.5 x 3.0 x [4.0].

145. Clumsy. Irregular. Slightly ground, straight edge. Slightly flared. White cortex on butt. Dull, grey-beige flint. 19.0 x 6.5 x 3.8 x [4.0].

146. Unground. Butt beveled. Edge convex. Axe curved in a fashion suggestive of the contemporary stone battle-axes, the *Double-edged axe*. Spotty, brown flint. More or less covered by a chalky, sand-colored patina. 18.0 x 5.0 x 3.5 x [4.0].

147. Chisel. Thick-butted. Unground. Square cross-section at butt. Marbled, grey flint. 11.5 x 1.5 x 1.5.

148. Chisel. Thick-butted. All sides polished. Chisel appears intentionally thinned by several blows at butt end, or maybe the thinning was a result of use. Rectangular cross-section at butt but square general cross-section. Could be assigned to the Single Grave Culture. Marbled, beige-brown flint. Patinated. 6.5 x 1.5 x 1.1 (at butt). Fig. 14d.

#### PITTED WARE CULTURE

Nos. 149 through 151 are arrow-points. They are typical implements of Pitted Ware people, but it must be emphasized that this sort of point also was used by Single Grave and Megalith peoples. It was associated with the compound bow (Brøndsted, 1957, 1:244).

149. Tanged. "Early Type." Fairly small. Triangular cross-section. Retouched on tang part only. Marbled, light-grey flint, almost translucent. 6.0 x 1.5 x 0.7. Fig. 15a.





Fig. 15. Pitted Ware Culture arrow-points. a. "Early Type"; b,c. "Late Type".

150. Tanged. "Late Type." Long. Slender. Triangular cross-section. Retouched on all surfaces. Parallel flaking. Grey flint. Patinated yellowish. 12.5 x 1.5 x 1.0. Fig. 15b.

151. As No. 150. Broken. Marbled, light-grey flint. (8.0) x 1.5 x 1.1. Fig. 15c.

#### SINGLE GRAVE CULTURE, IN JUTLAND

The Single Grave people came into Denmark by way of Jutland from northern Germany (Becker, 1954:114, 127; Glob, 1944:207). The early groups of these people are assigned to the *Bottom Grave*, the later to the *Ground Grave* and *Upper Grave* stages. Here they are considered only as early and late Single Grave people.

They were not flintsmiths before their arrival in Denmark. They were experts in working stone of other sorts, however, and speedily adapted themselves to flintworking techniques as well as to other cultural aspects of the life of the Megalith people. Nevertheless their work indicates that often they pecked and ground flint (as if it were, say greenstone) rather than flake it—an instance of cultural lag. They never became as expert flintworkers as the Megalith people.

Single Grave people adopted the types of flint axes they found in use when they arrived in Jutland. This makes it difficult to distinguish between a thick-butted axe made by a Megalith flintsmith and one made by a Single Grave flintsmith. Some of the artifacts listed below might just as well be assigned to the Megalith as to the Single Grave Culture.

Generally, however, (1) Single Grave axes are cruder in form than Megalith axes; (2) both their broad and narrow sides are convex; and (4) they often are pecked and ground from flint (Becker, 1936:184).

Axes used as tools were usually of flint. Battle-axes were made of stones other than flint, and were modeled on metal prototypes.

152. Axe. Ground. Incompletely polished on broad sides. Rectangular cross-section at butt. Butt pecked. Edge convex, damaged. Spotty, yellow-brown flint. Patinated. 13.0 x 5.0 x 2.5 x [3.1].

153. Axe. Ground. Incompletely polished. Rectangular cross-section at butt. Butt cut obliquely away from the broad sides. Edge convex, slanted, and somewhat drooping, an influence from contemporary battle-axes. Spotty, grey-brown flint. Patinated. 14.5 x 5.0 x 2.5 x [3.5].

154. Axe. As No. 153. One corner of butt beveled. Spotty, grey flint. Yellow-brown. Patinated. 17.5 x 5.0 x 2.5 x [3.5].

155. Axe. As No. 153, but with a fairly thin butt. Dull, grey-beige flint. 16.0 x 5.0 x 2.5 x [3.2].

156. Axe. Unground. Partly formed by pecking. Rectangular cross-section at butt. Butt straight. Edge slightly convex, somewhat flared. White cortex on butt. Brown flint. Patinated. 15.0 x 5.0 x 4.0 x [4.5].

157. Axe. Ground. Polished edge. Rectangular cross-section at butt. Butt beveled from one of broad sides. Edge slightly convex, slanted, worn. Yellow-brown flint. Patinated. 15.0 x 7.5 x 2.5 x [3.5].

158. Axe. Ground. Incompletely polished. Rectangular cross-section at butt. Butt irregular. Edge almost straight, drooping, an influence from contemporary battle-axes. Spotty, brownish-beige flint. Patinated. 15.0 x 5.0 x 2.5 x [3.5].

159. Axe. As No. 158, but with beveled butt. Yellow-beige flint. Patinated. 15.0 x 5.0 x 3.0 x [3.5].

160. Axe. As No. 159. Edge damaged. Dark grey-brown flint. 14.0 x 4.0 x 2.5 x [3.2].

161. Chisel. Thick-butted. Incomplete polish on all sides. Rectangular cross-section at butt. Butt shows marks of hammering. Spotty, beige-brown flint. Patinated. 16.0 x 2.7 x 1.5 x [2.2]. Fig. 16d.

162. Axe. Ground. Polished on broad sides. Almost square cross-section at butt. Butt straight. Edge slightly convex, very worn. Marbled grey flint. Patinated dull-beige. 16.0 x 6.0 x 3.0 x [3.5].

163. Axe. Ground. Incompletely polished on broad sides. Square cross-section at butt. Butt beveled. Edge slightly convex, slanted, unused. Marbled, dull, dark-grey-beige flint. Patinated. 15.1 x 4.0 x 3.2 x [3.7].

164. Axe. As No. 163, but with narrow butt and worn edge. Dull, grey-beige flint. 16.0 x 6.0 x 3.0 x [3.9].

165. Axe. Ground. Polished extensively on broad sides. Square cross-section at butt. Butt straight. Edge was damaged and resharpened but not repolished. White cortex on butt. Dull, grey-brown flint. Patinated. 15.0 x 6.0 x 3.5 x [4.0].

166. Axe. Ground. Polished on broad sides. Square cross-section at butt. Butt straight, narrow. Edge straight, somewhat worn. Brown flint. Patinated. 18.0 x 5.0 x 3.0 x [4.0].

167. Axe. Ground, but incompletely. Partly executed by pecking. Rectangular cross-section at butt. Butt heavy, beveled from one of the

broad sides. Edge convex, polished, elegant, damaged in one place. Brown-beige flint. Patinated. 15.5 x 5.0 x 2.5 x [4.7]. Figs. 16a, 17c.

168. Axe. Ground. Incompletely polished. Square cross-section at butt. Butt straight, narrow. Edge slightly convex, slanted, used. Dull, light-grey flint. Patinated beige. 14.5 x 5.0 x 3.0 x [3.5].

169. Adze. Ground. Incompletely polished. Square cross-section at butt. Butt narrow, beveled. Edge convex, worn. Dull, spotty, grey flint. Patinated brownish. 15.5 x 5.0 x 2.5 x [3.5].

170. Chisel. Incompletely polished. Square cross-section at butt. Edge damaged. Spotty, light-grey flint. 9.0 x 2.0 x 2.0. Fig. 16e.

#### SINGLE GRAVE CULTURE, ON THE DANISH ISLES

Flint axes of this manifestation of the Single Grave Culture are somewhat like those of the Schleswig-Holstein region of present Germany from which the Danish Isles Single Grave Culture came. (Becker, 1936:187-230; 1954a:118; Brøndsted, 1957, 1:294, 308; Glob, 1944:249-252). The Danish Isles axes are smaller than those of Jutland. Their technique of manufacture is more careless. A special group are thick, Point-butted adzes, four-sided, and often ground in furrows.

171. Battle-axe. Ground and polished. Small shafthole (2.5 diam.). Broad sides flat. Narrow sides convex. Butt tapering, "pinched," ending in a button. Axe curved in profile. Edge convex, drooping, somewhat slanting. Sandstone. 17.0 x 5.1 x 3.0. *Danish Isles Type*. This axe is exactly the same shape and size as the one found at Rye, Gørlev Parish, Holbaek Amt, National Museum [Denmark] No. A 20153-174 (Becker, 1936:161, Fig 24). Axes of this type are found in the later stages of the Single Grave Culture in Jutland and in Schleswig-Holstein. Figs. 18a, 19b.

172. Adze. Ground and incompletely polished on the broad sides. Four-sided. Butt narrow. Edge ground in furrows. Edge worn. Dull, grey-beige flint. Patinated. 15.0 x 5.0 x 2.5 x [3.0]. Figs. 18b, 19a.

173. Adze. Ground. Incompletely polished. Four-sided. Butt narrow, thick. Edge flared. Dull, grey-beige flint. Patinated. 13.0 x 5.0 x 2.0 x [3.0].

174. Adze. As No. 173. Narrow sides not polished. Grey-brown flint. Patinated. 10.0 x 3.5 x 1.7 x [2.0].





Fig. 16. Single Grave Culture. a. Thick-butted axe, early type; b. Thick-butted axe, late type; c. Thick-butted, flared axe; d,e. Thick-butted chisels.

175. Adze. As No. 173, but more irregular. Partly executed by pecking. Edge damaged. Grey-beige flint. Patinated. 11.5 x 5.0 x 2.3 x [2.9].

176. Adze. As No. 173, but small and triangular. Butt beveled. Edge ground in furrows. Typical for the Dansih Isles of this period. Grey-beige flint. Patinated. 10.0 x 4.5 x 2.3 x [2.4]. Figs. 18c, 19c.

Nos. 177-179 are three axes differing in style from the others in this collection. The closest parallel to them was a small axe believed by Becker (1936:209, fig.44) to have been imported from the region of the Oder. They are probably Single Grave Culture artifacts, however, and are probably not very early.

177. Axe. Slender. Four-sided. Irregular. Two sides at butt. The two broad sides meet here to form an edge. One broad side ground and polished toward the edge. Edge slightly convex. Worn. Other broad side unworked, except at the edge, and made up of white nodular cortex. Spotty, dark grey-brown flint. Patinated. 15.5 x 4.0 x 2.1 x [2.8].



178. Axe. Much like No. 177. Smaller. Worked on both sides. Butt thin and straight. Spotty, dark-grey-brown flint. Patinated. 11.0 x 4.0 x 1.5 x [2.1]. Figs. 18d, 19d.

179. Axe. Triangular. Four-sided except at butt where it is like 177. Thin. Very irregular. One side made up of white nodular cortex. Edge ground and polished. Edge very worn. Slightly S-shaped profile over-all. Spotty, dark-grey-brown flint. Patinated. 8.9 x 3.5 x 1.3 x [1.5].

#### LATE SINGLE GRAVE OR UPPER GRAVE TIME

Flint axes generally smaller and less finely worked than those of the preceding period. Axes are four-sided.

180. Axe. Ground. Incompletely polished on broad sides. Rectangular cross-section at butt. Butt beveled from one of the broad sides.



Fig. 17. Comparison of profiles between Funnel-necked Beaker Culture E and Single Grave Culture axes. a. Lindø type; b. Valby type; c. Early Single Grave type; d. Late Single Grave type. The axes are foreshortened in the picture.



Fig. 18. Danish Isles Culture. Profile view of adzes and axes. **a.** Battle-axe; **b,c.** Point-butted, four-sided adzes; **d.** Thin-butted axe. The implements are slightly foreshortened.

Edge almost straight, slanted. Dull, beige flint. Patinated. 13.5 x 5.0 x 3.0 x [3.3].

181. Axe. Ground. Incompletely polished. Square cross-section at butt. Butt clumsy. Butt shows signs of hammering or pecking. Edge slightly convex, slanted, damaged. Dull, beige flint. Patinated. 14.0 x 4.0 x 3.0 x [4.0].

182. Axe. Ground. Incompletely polished on broad sides. Slender. Rectangular cross-section at butt. Butt beveled. Edge convex, some-

what slanted. White cortex on butt. Marbled grey flint. 14.0 x 4.0 x 2.0 x [2.3].

183. Axe. Much like 182 but more extensively polished. Butt tapered almost to a point. Edge damaged in one corner. White cortex left on one broad side. Brown flint. Patinated. 14.0 x 4.0 x 1.7 x [2.2].

184. Axe. Ground. Incompletely polished on broad sides. Small. Almost triangular. Square cross-section at butt. Butt pointed. Edge slightly convex, damaged. Dull, beige-brown flint. Patinated. 12.0 x 3.5 x 2.3 x [2.5].

185. Axe. As No. 182. Yellow-brown flint. Patinated. 13.0 x 3.5 x 2.0 x [2.5]. Fig. 20a.

186. Axe. Originally ground and polished smooth on all sides, and very regular but later reshaped by unskilled chipping. Slender. Square cross-section at butt. Butt rounded. Edge almost straight, resharpened



Fig. 19. Danish Isles Culture. Frontal view of adzes and axes. a. Point-butt, four-sided adze; b. Battle-axe; c. Point-butt, four-sided adze; d. Thin-butt axe.

even after reshaping of the axe. Marbled, yellow-grey flint. Patinated. 13.0 x 4.5 x 2.4 x [2.5].

#### DAGGER PERIOD

During the early and middle Neolithic time, the descendants of the Ertebølle and Gudenaa people survived, absorbing some influence from the megalith builders. They continued to live in the coastal regions of Jutland and the sandy, wooded areas around the river Gudenaa, territory the megalith builders scorned for the practice of their agricultural pursuits (Mathiassen, 1937:124-139).

The peoples of the Single Grave Cultures, however, accepted the easily tilled sandy soils the megalith builders had rejected as well as the soils the megalith builders had preferred, and they settled over the entire area. By the late Neolithic they had probably absorbed the remnants of both the Ertebølle and Gudenaa Cultures and perhaps also the Megalith Culture.

How peaceful or how warlike this process was, we do not know. We are not positive that the absorption of the earlier inhabitants of the country was complete. We do know, however, that by the late Neolithic, control of the land was in the hands of the Single Grave peoples (Brøndsted, 1957,1:309-310). After this time no more megalith graves were erected (Brøndsted, 1957,1: 335). Some megalith graves were despoiled of their original group burials to make way for the interment of a warrior of the Single Grave people.

The whole cultural pattern changed into that of the semi-agricultural Single Grave peoples. From this merger of indigenous and invading groups came the people who developed the stately Bronze Age culture, which, in Denmark, reached a very high level indeed.

Two traditions in flint work continued side by side during the Upper Grave Period. One—No. 185 is an example—is represented by small, crude, irregular flint axes that give the impression of being degenerate forms of the axes of Bottom Grave times which were, themselves, not fine work. Fig. 16b.

The other tradition—No. 274 is an example but a poor one—is represented by regular, flat, four-sided axes with narrow butts and flared edges done with good technique. Fig. 16c. They are clearly patterned after contemporary copper and bronze axes. It is most tempting to suppose this second tradition is the work of flintsmiths who have not yet abandoned the megalith feeling for fine craftsmanship (Brøndsted, 1957, 1: 336).



With the coming of bronze and copper in quantity to Scandinavia, flint work suddenly reached its peak as if the flintsmiths were fighting for their livelihoods. Parallel flaking was exquisitely performed. New forms of flint artifacts came into existence. They were patterned after metal prototypes. The chief weapons made were daggers (which gave their name to the whole period) and spears. Neither requires as much metal as a battle-axe. Flint axes continued to be made for use as ordinary tools, but stone battle-axes were no longer made. During recent years some scholars have come to think that the many new tool forms in the Dagger Period may have been introduced through immigration rather than acculturation (Becker, 1964: 131-132; Kaelas, 1964: 142-143). Further study is needed before a conclusion can be reached.

Semilunar knives and sickles of flint also were made. Most of the tool forms used in the Dagger Period also were used during the first phase of the Bronze Age.

Flint daggers of this period were classified and dated by Müller (1902,1:4) and Forssander (1936). Forssander arranged them into six chronological classes, the last of which he placed in the first period of the Bronze Age (1936, Fig.1). There are, however, several transitional forms, and it is probably unrealistic to believe in the validity of a strict chronological schema. Various types may well have existed side by side. For our purpose it is enough to mention three major types, to note that Type 1 was the first form of flint dagger to be used, and that Type 3 is generally later than Type 2:

Type 1. Oldest type, which survived throughout the period—fairly small and lanceolate. Fig. 20b.

Type 2. Middle type—long, heavy, handle fairly thick, cross-section of handle a pointed oval or rhomboid. Fig. 20c.

Type 3. Latest type—smaller, with a clearly marked shoulder and a handle with concave sides and wide tops. They are often exact copies of bronze or copper daggers. This collection contains no whole specimen of this type.

Flint daggers, similar to Types 2 and 3, were used in the beginning of the Bronze Age, mainly in the time generally referred to as Period I. They have a handle that resembles a tang more than a real handle. Fig. 20d.

187. Axe or hammer. Short, heavy. Triangular. Shaft hole (2.5 in diameter). Edge very blunt. Butt concave. Igneous rock. 9.5 x 6.0 x 5.7 Fig. 20a.



188. Dagger or knife. Broken at handle. Lanceolate. Sharp point. Crudely made. Dull, brown flint. Patinated. 15.0 x 5.0 x 1.6.

189. The number originally given to this specimen was later changed to 114a (*see*).

190. Knife. Narrow, heavy blade. Point broken off in antiquity. May have been resharpened. Broken in handle end. Marbled, grey flint. (8.5) x 3.0 x 1.1.



Fig. 20. Dagger Period and Early Bronze Age. a. Concave-butted axe with hafting-hole; b. Dagger, Type 1; c. Dagger, Type 2; d. Dagger, type used in Bronze Age Period I. The implements are foreshortened.

191. Knife. Short, heavy blade. Slightly twisted and curved to one side. Spotty, grey flint. 9.0 x 2.3 x 1.2.

#### DAGGERS OF TYPE 1

192. Lower half of flint dagger. Lanceolate. Fracture on one edge. Spotty, grey flint. (8.5) x 3.0 x 1.3.

193. Lower half of dagger. Somewhat crooked blade. Point broken off. Partly ground. Spotty, dull, yellow-brown flint. Patinated. (9.5) x 3.0 x 1.0.

194. Dagger. Slender. Lanceolate. Spotty, dark-grey flint. 14.5 x 2.5 x 0.7. Fig. 20b.

195. Dagger. Narrow. Lanceolate. Retouched with parallel flaking. Spotty, grey flint. 14.5 x 2.5 x 0.8.

196. Dagger. Fairly broad. Lanceolate. Wider in handle end. Four fractures on one edge. One on the other. Spotty, grey flint. 15.0 x 4.0 x 0.9.

197. Dagger. Lanceolate. Thicker and wider in one end. Old fracture on one broad side. Dull, beige flint. Patinated; rusty patina over whole blade. 13.0 x 2.5 x 1.1.

198. Dagger. Transition stage between Types 1 and 2. Point broken off. Parallel flaked. Spotty, grey flint. Patinated. 17.5 x 3.5 x 1.3.

#### DAGGERS OF TYPE 2

199. Middle part of dagger apparently much like No. 198 when whole. Spotty, dark-grey flint. (6.0) x 3.5 x 1.0.

200. Dagger. Long. Thick, triangular handle or tang. Point broken off. Parallel flaked. Spotty, dark-grey flint. 16.0 x 3.0 x 1.1.

201. Dagger. Long. Thick, wide. One end shaped as a handle. Other end pointed. Partly ground. Parallel flaked. White cortex on handle. Spotty, dark-brown flint. Patinated. 23.5 x 3.8 x 1.4. Fig. 20c.

202. Upper part of dagger. Much as No. 200. Parallel flaked. Spotty, dark-grey flint. (13.0) x 3.0 x 0.9.

203. Dagger. Short. Point broken off: Parallel flaked. Spotty, dark-grey flint. 12.5 x 2.5 x 1.3.

204. Lower part of dagger. Broken in three pieces. Parallel flaked. Marbled, grey flint. Patinated grey brown. (12.0) x 3.0 x 0.6.

205. Part of dagger. Very thin blade. Fracture on one edge. Parallel flaked. Spotty, light-grey flint. (9.8) x 3.0 x 0.8.

206. Dagger blade. Parallel flaked. Marbled, light-grey flint. (11.0) x 2.0 x 0.9.

207. Lower part of dagger. Parallel flaked. Marbled, grey flint. (6.5) x 2.0 x 0.7.

208. Lower part of dagger. Parallel flaked. Spotty, grey flint. Patinated brown. (7.0) x 2.5 x 0.8.

209. Point of dagger. Parallel flaked. Marbled, light-grey flint. (4.0) x 1.0 x 0.7.

#### DAGGERS OF TYPE 3 AND BRONZE AGE PERIOD I

210. Dagger blade. Probably of Type 3. Spotty, grey flint. Patinated beige in some spots. (10.5) x 3.5 x 0.7.

211. Blade of dagger of Type 3 or spear-head. Exquisite ripple flaking. Spotty, brown flint. (15.0) x 4.0 x 0.9.

212. Dagger. Triangular blade. Marked angular shoulders. Straight handle. Bronze Age Period I. Spotty, grey flint. 15.0 x 3.5 x 0.9.

213. Dagger. Lanceolate blade. Rounded shoulders. Straight handle, thicker in cross-section than blade. Bronze Age Period I. Dull beige flint. Patinated. 18.0 x 4.0 x 1.1. Fig. 20d.

#### DOMESTIC KNIVES

These knives are called "domestic" since it is thought that people ate with them, and that they are distinct from knives that were conventional tools or weapons.

214. Domestic knife. Thin, wide blade. Point rather wide. Two fractures on one edge. Spotty brown flint. Patinated. 19.0 x 4.0 x 1.0.

215. Domestic knife. Blade heavier than No. 214. Handle part broken off in antiquity. Blade's sides more or less parallel. Meet softly to form a short point. Marbled grey flint. (12.5) x 4.0 x 1.5. Fig. 22a. Could have been used as a halberd blade rather than domestic knife (Almgren, 1962).

216. Lower part of domestic knife, or palstaff. Triangular blade. Point broken off in antiquity. Spotty, grey flint. (8.0) x 4.0 x 0.9. A few such triangular flint blades are known. Their dating and use have been discussed. Bjørn compares them to pointed axes like No. 114A of this collection. He believes they are late Neolithic and were used as palstaffs (Bjørn, 1935:3-4). Hinsch believes they were made in the early Neolithic and used as daggers (1955:50-51, fig. 6).

#### ARROW-POINTS, SPEARHEADS

217. Arrow-point or small spearhead. Blade triangular. Thin, pointed oval cross-section. Tang broad and heavy. Marbled, light-grey flint. 7.5 x 3.5 x 0.8.

218. Arrow-point or spearhead. Blade lanceolate. Tang broad. Exquisite parallel flaking. Spotty light-grey flint. 9.0 x 3.0 x 0.8. Fig. 21c.

219. Spearhead. Might be small dagger. Blade triangular. Shoulders angular. Tang thick. Parallel flaked. Spotty, grey flint. 10.0 x 2.5 x 0.9.

220. Arrow-head or spearpoint. Lanceolate. Fracture on one edge. Spotty, light-grey flint. 10.5 x 3.0 x 0.8.

221. Spearhead. Narrow. Lanceolate. Parallel flaked. Somewhat ground. Marbled, dark-beige flint. Patinated. 10.0 x 2.3 x 0.8.

222. As No. 221. Spotty, yellow-beige flint. Patinated. 12.5 x 2.3 x 0.8.

223. As No. 221. Spotty, dull-beige flint. Patinated. 12.0 x 2.5 x 0.8.

224. As No. 221. Spotty, dark-grey flint. 13.0 x 2.5 x 0.7.

225. Spearhead. Lanceolate. Incompletely ground on one side. Marbled, grey flint. 11.0 x 3.0 x 1.0.

226. As No. 225. Spotty, dark-grey flint. 11.0 x 3.5 x 0.8.

227. Spearhead. Lanceolate. Wide. Marbled, beige flint. Patinated. 15.5 x 4.0 x 1.0.

228. As No. 227 but not so wide. Spotty, dark-grey-brown flint. Patinated. 15.3 x 3.0 x 1.0.

229. Spearhead. Huge. Lanceolate. Executed by excellent parallel flaking. Blade broken in two. This style of spearhead typical for Early-Middle Dagger Period. Some white cortex. Spotty, dark-grey flint. 18.5 x 4.0 x 0.8. Fig. 21b.



Fig. 21. Late Dagger Period and early Bronze Age. a. Lower part of sword or knife; b. Spearhead; c. Arrow-point.

#### SEMI-LUNATE KNIVES AND SICKLES

230. Sickle. Thin. Parallel flaked at edges. Spotty, dark-grey flint. 7.0 x 3.0 x 0.6.

231. Sickle. Thin. Elegant. Parallel flaked at edges. Sickle polish along straight edge. Spotty, dark-grey-brown flint. Patinated. 11.0 x 5.0 x 0.9. Fig. 22c.



232. As No. 231. Spotty, dark-grey flint. 10.0 x 4.5 x 0.9.

233. End-piece of semi-lunate knife. Thick in cross-section. Spotty, grey flint. Some sand-colored cortex on one side. (4.5) x 4.5 x 0.8.

234. As No. 233. Base slightly concave. Unremoved protuberance on one side. Spotty, grey flint. (5.0) x 4.0 x 1.3. (1.3 measurement due to protuberance.)

235. As No. 233. Thinner than No. 233. Concave base. Spotty, grey flint. (7.0) x 4.0 x 0.9.

236. Sickles. Comma-shaped. One end broken. Thick cross-section. Recent fracture on edge. Several ancient fractures. Sickles polish along concave edge. Spotty, yellow-to-grey flint. Patinated. Originally about 9.5 x 2.2 x 0.9.

237. Sickles. Comma-shaped. Sickles polish along concave edge. Two ancient fractures along the edge. Marbled, grey flint. 7.5 x 2.5 x 1.0.

238. Sickles. Comma-shaped. Broken at one end. Some parallel flaking. Marbled, grey flint. Originally about 9.0 x 3.0 x 0.7.



Fig. 22. Dagger Period or early Bronze Age. a. "Domestic" knife; b,c. Sickles.

239. Sickle. Comma-shaped. Broken at one end. Marbled, grey flint. Originally about 9.0 x 2.5 x 0.8.

240. Sickle. Straight base. Edge worn. Spotty, yellowish-white flint. Heavily patinated. Somewhat rounded and may have been rolled. 11.5 x 3.3 x 0.8.

241. Sickle. Comma-shaped. Fine parallel flaking. Sickle polish along concave edge. Spotty, dark-grey flint. 11.0 x 3.0 x 0.8.

242. Sickle. Almost straight base. Sickle polish along straight edge. Spotty, brown flint. Patinated. 10.0 x 3.0 x 0.9.

243. Sickle. Comma-shaped. Parallel flaking. Spotty, grey flint. 10.0 x 2.8 x 0.9.

244. Sickle. Comma-shaped. Broken at one end. Some parallel flaking. One fracture on base. Spotty, grey flint. Originally about 10.0 x 3.0 x 0.7.

245. Sickle. Comma-shaped. Blade strongly curved. Parallel flaking. Ends broken off. Concave edge fractured in three places. Has sickle polish. Spotty, brown flint. Patinated. Originally about 12.0 x 3.0 x 0.7. Fig. 22b.

#### PROVENIENCE OF ARTIFACTS

Some pieces of Accession 19770 had legible labels giving their provenience and year of finding. The specimens come from all periods of the Neolithic. Localities are: (1) Sjørring Sø, (2) Skjoldborg, (3) Hundborg, and (4) Jannerup, all lying 7 to 10 kilometers west of Tisted on the Limfiord in northwest Jutland; (5) Biersted Kaep, which is about 10 kilometers north of the Limfiord, 10 kilometers northwest of Aalborg; and (6) Aarup, which is on the western Funen, about 20 kilometers west of Odense.

#### SJØRRING SØ

246. Axe. Four-sided. Narrow and broad sides somewhat convex. Butt straight, rectangular in cross-section, fairly heavy. Edge heavily damaged. Related to both "Old Type" of flint axe and the "Bundsø Type." Greenstone. Probably D. Found in 1890. 14.0 x 4.5 x 2.5 x [3.7]. Fig. 10b.

247. Axe. Thin-bladed. Four-sided. Polished on all sides. Butt thin, convex. Edge convex. Broad sides slightly convex. Beige flint. Patinated. D. Found in 1883. 12.0 x 5.0 x 1.0 [1.8]. Figs. 12b, 13b.

248. Axe. Thin-bladed. Four sided. Narrow sides straight. Broad sides polished. Butt thin, convex. Edge convex. Very regular. Related to the "Blandebjerg Type." Beige flint. Patinated. D. Found in 1880. 14.0 x 4.5 x 1.0 x [1.2].

249. Axe. Thin-bladed. Could be chisel. Four-sided. Incompletely polished on broad sides. Edge slightly flared. Butt beveled. Damaged. Edge damaged and resharpened. Marbled, beige flint. Patinated. D. Found in 1892. 8.0. x 3.0 x 0.7 x [1.1].

250. Axe. Thickbutted. Lindø type. Broad sides incompletely polished. Butt thick, rectangular, straight. Edge flared, damaged from use. Spotty, dark-grey flint. E. Found in 1884. 8.5 x 2.5 x 1.4 x [2.0].

251. Axe. As No. 250, although larger and of Valby type. Butt straight. Edge damaged. Dark, dull grey flint. Patinated to a lighter grey in places. E. Found in 1891. 10.0 x 3.5 x 1.9 x [2.4].

252. Axe. Thick-butted. Four-sided. Sides slightly convex. Broad sides incompletely polished. Butt straight. Rectangular in cross section. Edge convex, damaged. Some white cortex on one broad side. Spotty, dull, beige flint. Patinated. Crude specimen of the early Single Grave period. 14.5 x 4.5 x 2.2 x [3.0].

253. Axe. Thick-butted. Four-sided. Broad sides incompletely polished. Butt straight. Square in cross section. Edge slightly convex, damaged. Dull, beige flint. Patinated. Single Grave type. Found in 1888. 13.5 x 4.0 x 2.6 x [3.1].

254. Dagger. Short. Type 2, one end slightly thicker and shaped as a handle. Spotty, dark-grey flint. Dagger Period, middle. Found in 1893. 12.0 x 3.0 x 0.8.

255. Dagger blade. Type 2. Some parallel flaking. Small spot of sand-colored cortex near point. Spotty, brownish flint. Patinated. Dagger Period, middle. Found in 1881. 14.0 x 3.3 x 1.1.

256. Point of dagger. Type 2. Fracture on one edge. Excellent parallel flaking. Spotty, grey flint. Dagger Period, middle. Found in 1886. (8.0) x 2.0 x 0.7.

257. Domestic knife. Lower part of heavy blade. As No. 216. Point extremity broken off. Small fracture along edges. Some parallel flaking. Spotty, dark-grey flint. Thick patination on one side, first brown, and later grey-white-beige. Dagger Period. (12.5) x 3.7 x 1.3.

258. Spear-point. Lanceolate. Wide. Fracture near point. Broken in one end. Spotty, brown flint. Patinated. Dagger Period, early or middle. Found in 1894. Originally about 13.5 x 3.3 x 0.7.

259. Spearhead. Lanceolate. Big. Wide. Edges fractured in seven places. Grey flint. Thick white-green-brown patination. Dagger Period, early or middle. Found in 1891. 18.0 x 4.5 x 0.8.

260. Sword ? Lower half of flint implement. Blade wide, elegant. One edge straight, the other curved so the point is on one side. Some white cortex on one side. Parallel flaking. Dark-grey flint. Dagger Period, late, or Bronze Age Period I. Found in 1889. 15.0 x 5.0 x 1.2. Fig. 21a. Almgren (1962) believes this might be considered a pointed axe used as a halberd similar to 189. If so, it would be early middle Neolithic rather than late Neolithic. Flint swords were copied after bronze prototypes and were very well made. Their practical use was probably limited since a flint blade of this size is fragile. The most famous of these flint swords is one from Ätte, in Schleswig, and one from Favrskov on Funen. The latter is copied from an oriental curved sword.

261. Heavy knife. Lower part. Curved so that point is on one side. Thick cross-section. Spotty, grey flint. Dagger Period, early or middle. Found in 1894. (10.0) x 4.4 x 1.3.

262. Domestic knife. Blade. Triangular. Big. Crude. Broken at one end. Chipped point and edges. Some white cortex. Spotty, grey flint. Dagger Period, early or middle. (11.0) x 5.8 x 1.0.

#### SKJOLDBORG

263. Axe. Thin-butted. "Old Type." Both broad and narrow sides slightly convex. All sides polished. Butt double-beveled. Edge damaged, reshaped in crude fashion. Beige flint. Patinated. C or early D. 17.0 x 6.5 x 1.5 x [2.7].

264. Axe. Thick-butted "Bundsø Type." Unfinished. Unground. Butt convex, obliquely cut. Edge convex. Spotty, dull, grey-beige flint. D to E. Found in 1887. 21.0 x 7.5 x 2.8 x [4.5].

265. Axe. Thick-butted "Lindø Type." Long. Edge slightly flared. All sides ground and incompletely polished. Edge damaged. Dull, beige flint. Patinated. E. Found in 1893. 21.5 x 6.5 x 4.0 x [4.7]. Fig. 14b.



266. Axe. As No. 265 but with only the broad sides polished. Edge polished to perfect smoothness. Marbled, grey-brown flint. Patinated. E. Found in 1882. 21.5 x 6.0 x 3.2 x [3.6].

267. Axe. As No. 265. Edge damaged. Spotty, grey flint. Patinated beige. E. Found in 1884. 16.0 x 5.0 x 2.6 x [3.5].

268. Arrow-point. Long. Slender. Triangular cross section. Parallel flaked. Broken. One end missing. Dark-grey flint. Pitted Ware Culture type. Found in 1893. (12.0) x 1.0 x 0.8.

269. Axe. Thick-butted. Broad sides incompletely polished. Butt straight. Rectangular in cross section. Edge slightly flared, reshaped by clumsy cutting. Spotty, grey flint. E or early Single Grave Period. Found in 1882. 14.5 x 5.0 x 2.5 x [3.2].

270. Axe. Small. Thick-butted. Broad sides incompletely polished. Butt rounded. Rectangular in cross section. Edge straight, slanted. Spotty, dull, beige flint. Patinated. Late Single Grave Period. Found in 1897. 13.6 x 4.7 x 2.8 x [3.0].

271. Chisel. Thick-butted. Two sides polished. Square cross section. Beige flint. Patinated. Single Grave Period. Found in 1884. 7.0 x 1.5 x 1.3.

#### HUNDBORG

272. Axe. Thin-butted. "Old Type." Unfinished. Unground. Butt convex. Edge convex. All sides slightly convex. Spotty, brown flint. Patinated. C or D. Found in 1887. 16.5 x 6.5 x 2.0 x [3.1].

273. Axe. Thin-bladed "Old Type." Small. Butt straight. Edge damaged. All sides convex, polished. Dull, beige flint. Patinated. D. Found in 1898. 10.0 x 4.5 x 1.1 x [2.1].

274. Axe. Thick-butted. Butt rectangular. Edge convex, flared. Broad sides partially ground. Dull, light-grey flint. Patinated beige. Late Single Grave Culture. Found in 1894. 14.0 x 4.5 x 2.2 x [2.5]. Fig. 16c.

275. Spearhead. Lanceolate. Big. Wide. Dark-grey, spotty flint. Dagger Period, middle. 13.0 x 4.0 x 0.8.

#### JANNERUP

276. Axe. Thin-butted. "Old Type." Incompletely polished on all sides. Butt irregular, chipped at a later date. Edge convex, damaged. Yellow-beige flint. Patinated. C. Found in 1887. 11.5 x 6.0 x 1.7 x [3.1].



## BIERSTED KAEP

277. Axe. Thick-butted. Broad sides incompletely polished. Butt straight. Square cross-section. Edge flared, heavily damaged. Dull, grey-white flint. Single Grave Culture, Ground Grave time. Found in 1891. 15.0 x 4.5 x 2.5 x [3.0].

## AARUP

278. Axe. Thin-butted. "Blandebjerg Type." Broad sides polished. Long, slender. Butt convex. Edge convex. Brown flint. Patinated. D. Found in 1889. 18.0 x 6.0 x 1.2 x [2.5].

279. Axe. Thick-butted. Broad sides incompletely polished. Polished smooth toward the edge. Butt irregular; beveled from one of the broad sides. Edge slightly convex, slanted. Some white cortex on one side. Spotty, dull, beige flint. Heavily patinated. Early Single Grave Culture. Found in 1894. 14.0 x 5.0 x 2.7 x [3.0].

## IRON AGE

Exact dating of Nos. 280 through 335 is not possible. They are probably of a fairly late period.

280. Ferrule of iron. Unfinished. Core of stone still inside. Thin sheet of iron, partially rusted away, tightly wrapped around a stone core. 13.0 long, 3.0 diameter at base.

281. Whetstone. One end shaped as a handle. One side in particular shows signs of much use. Slate. 35.0 x 3.0 x 1.0. Probably Viking Period (A.D. 800-1100) or later (cf. Petersen, 1951:254). Fig. 23b.

282. One end shaped as a handle. Sandstone. 35.0 x 1.5 x 1.5. Probably Viking Period (A.D. 800-1100) or later. Fig. 23a.

283. Piece of whetstone. Much like 282. Cross-section almost square. Sandstone. (11.0) x 1.7 x 1.4. Probably Viking Period (A.D. 800-1100) or later.

284. Weight ? Round, polished ball of stone. 4.3 cm., diameter. 136.8 gm., weight. Fig. 23f.

285. Weight ? As No. 284. 3 cm., diameter. 41.15 gm., weight. Fig. 23f.

286. Weight ? As No. 284. 1.5 cm., diameter. 5.2 gm., weight. Fig. 23f.

287. Weight ? As No. 284. 1.3 cm., diameter. 3.1 gm., weight.



Fig. 23. Late Iron Age. a,b. Whetstones; c. Sinker; d. "Belt-stone"; e. Fossil echinoids; f. Weights? Size of implements is indicated by 15-cm. scale.

Nos. 288 through 325 are fossil sea urchins (Echinodermata of the class Echinoidea). It is possible they were used as gaming pieces. Backgammon was a popular game from the late Roman Period (A.D. 200-400) on, and sets of gaming pieces, dice, and boards were often made as funeral gifts. The gaming pieces were semi-spherical and made of many materials, including bone, clay, glass, and stone. Some gaming pieces of amber found in the Vimose (a bog on Funen in Denmark) were carved in a pattern much like the natural pattern of these echinoids (cf. Brøndsted, 1960,3:Fig.b on 200), and a sea urchin used as a gaming piece was found in Norway (Petersen, 1914:89, 91, Fig.26). Since we have no knowledge of the exact provenience of the following specimens, however, we cannot say they were gaming pieces. It may be that the collector thought they were prehistoric implements and therefore picked them up.

In the descriptions below, the approximate diameters and subsidiary characters only are noted.

288. 4.5.

289. 4.0. Rolled. Fig. 23e.

290. 3.7. Rolled.

291. 3.7. Rolled.

292. 3.5. Rolled.

293. 3.5. Rolled.

294. 3.5. Rolled.

295. 3.5. Rolled. Fig. 23e.

296. 3.5.

297. 3.5. Rolled.

298. 3.5. Rolled.

299. 3.5.

300. 3.5. Rolled.

301. 3.0.

302. 3.0. Rolled.

303. 3.0.

304. 3.0. Rolled.

305. 3.0.

306. 2.5. Rolled.

307. 2.5.

308. 2.5. Rolled.

309. 2.5.

310. 2.5. Rolled.

311. 2.5.

312. 2.5. Rolled.

313. 2.5. Rolled.

314. 2.5. Rolled.

315. 2.5.

316. 2.0. Rolled.

317. 2.0. Rolled.

318. 2.0. Rolled.

319. 2.0. Rolled.

320. 2.0. Rolled.

321. 2.0. Rolled.

322. 2.0.

323. 2.0. Rolled.

324. 1.5. Rolled.

325. 1.0.

326. Fire-striking stone. Oval. Four-sided. Broad, oval sides flat. Narrow sides concave, providing a fastening groove. Quartzite. 7.5 x 2.5 x 3.4. Fig 23d. This type is often called "belt stone" in Scandinavian terminology because it was carried on the belt.

327. Sinkers. Plum-shaped. Four grooves for fastening ropes. Granite. 10.5 x 5.0. Fig. 23c.

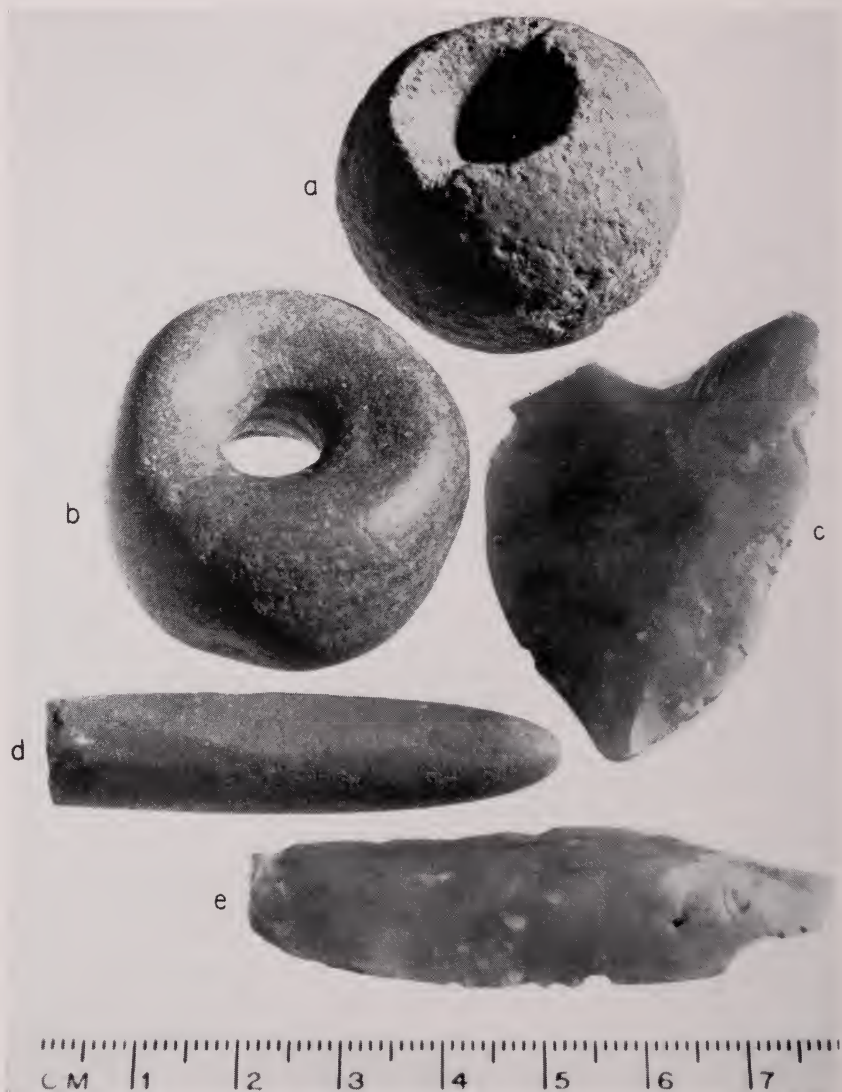


Fig. 24. Iron Age and undated material. a,b. Spindle whorls; c. Point; d. Drill; e. Burin-knife.

328. Spindle-whorl. Could be a loom-weight. Uneven. Soapstone. About 4.0 x 1.5. Fig. 24b. Probably Migration Period (A.D. 400-600; cf. Petersen, 1933:18-19; 1951:302).



329. Spindle-whorl. Unfinished. Drillings started on both sides but hole not completed. Granite. 4.0 x 2.6. Fig. 24a. Probably Migration Period (A.D. 400-600).

330. Drill. Stone or fossil. 4.5 x 1.1. Fig. 24d.

331. Broken, branched piece of fossil. 8.0 x 0.8.

332. Lump of amber.

333. Flake. Straight in profile. More or less heart-shaped. Base fluted. Sides flared to wings. One wing broken off in antiquity. Six indentations along edge. Two side notches. No retouch. Polished on dorsal surface either before or after the flake was detached. Bulbar surface polished with resultant smoothing of ripple marks and bulb of percussion. The striking platform, which was at the pointed end, was removed. The point was shaped by blows, similar to those of a burin, to each side of the point, perpendicular to the dorsal and bulbar surfaces, making the right edge 0.1 thick and the left one less than 0.1. Thin cross-section. Dark-grey, spotty flint. 6.0 x 3.5 x 0.5. Fig. 24c. This type of point is uncommon in Scandinavia. Heart-shaped arrow-points do occur in the Dagger Period and early Bronze Age, but their style is entirely different and they are retouched by parallel flaking. If this point was struck from a polished specimen, an axe, for instance, secondary trimming may have been unnecessary.

334. Flint nodule. Sausage-shaped. Fairly sharp at one end, where it is slightly chipped, maybe from use. Almost black. Cortex is smooth, in various shades of grey and grey-beige. 12.1 x 4.6 x 3.0.

335. Flint nodule. L-shaped. Pointed and chipped at one end. It may have been used as a tool. Almost black. Cortex smooth, dark-grey-brown, lighter on one side. One arm, 16.0 x 5.0; other arm, 15.0 x 6.0.

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HERPETOLOGICAL TYPE-SPECIMENS IN  
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During a half-century of research on recent amphibians and reptiles a collection of over 76,000 specimens has been amassed in Carnegie Museum. Included in this collection are approximately 870 type-specimens: specimens which have formed the basis for taxonomic descriptions. Type-specimens are especially useful to the systematic zoologist since they provide a means of re-evaluating previous work and a basis for comparison of new materials. They constitute the reference library of systematic zoology, and are the final authority in zoological nomenclature. Catalogues of type-specimens provide the index and key to these reference collections, and are invaluable tools for the working systematist. The International Commission on Zoological Nomenclature recognizes the importance of type-specimen collections, and recommends that institutions publish lists of the types under their care. This list of type-specimens has been prepared partly to discharge this institutional responsibility.

We have arranged the entries alphabetically by orders, except that the snakes and lizards are listed separately. Each original name is followed by an abbreviated bibliographic reference to the description, and by the location of the holotype specimen, if not in Carnegie Museum. In some cases we also give a synonym or current combination of the name, with a reference to our authority for the synonymy or new combination. Changed combinations of valid taxa are also listed in alphabetical sequence, with a reference to the original name under which the type-specimen information appears. The Carnegie Museum catalogue numbers appear in boldface, followed by the collection data for each type-specimen. If a type-specimen previously bore a catalogue number in another institutional collection that number is recorded at the



end of the citation. Since the original names and current combinations both appear within a single alphabetical sequence, no index should be necessary.

Published lists of herpetological type-specimens have variously included, or very pointedly omitted, the current status of the taxa listed, and our approach to this problem requires explanation. An extreme view is obvious in recent lists which present only the original names and combinations, with no indication of synonymy. The justification for this method is that the value of the information in such a list is permanent, and not subject to change by vagaries of opinion. There is also good reason for considering the objective recording of type-specimen location and the subjective determination of current status of names as separate functions of the systematist, which have no place together in a type-specimen list. And we appreciate the ephemerality of some current name combinations, but we do not agree that they have no place in type-specimen catalogues. It is our opinion that lists of type-specimens will be of value primarily as working tools of the systematist. Listing of a synonym or current combination approximately doubles the information content of each type citation. This, we believe, will make this list more useful: sufficient reason for including information that is possibly ephemeral. It should be kept in mind that even were the synonyms and citations of current status all obsolete within a year, the list would retain the basic information content of a list prepared without current status designations.

Further, the argument has been raised that consistent citation of current status for taxa, including the broad range of names represented in a type list, is impossible. We admit to inconsistencies of treatment, but for those taxa so treated, the synonym or new combination reflects the current taxonomic standing of the name. Our allocations of names are based exclusively on the published literature; when possible, on the synoptic and current summary literature. Each synonym or change of combination is accompanied by a reference to the first use of the name in the sense that we recognize it, and occasionally by additional references to review literature bearing on the specific case. This list contains no new allocations to synonymy or changes of name combinations.

The type-specimens in the collection have several sources. A large part of them represents material originally either collected or described, or both, by Carnegie Museum staff members. Additional typical material has been acquired by purchase, notably the types of the species

described from the Philippines by E. H. Taylor. The remainder, including a majority of the taxa represented, have been deposited as gifts to Carnegie Museum or obtained through exchanges. To all of those specialists and institutions who have thus enriched the collections of Carnegie Museum we owe our thanks. The 193 taxa represented in the type collection include one species of caecilian, 51 forms of salamanders, 32 of salientians, 3 of turtles, 51 of lizards, and 55 of snakes. The geographic balance reflects the history of specialization of the department, with 61 United States forms represented, 68 from Latin America, 13 from Africa, and 51 from Asia.

Abbreviations of the names of institutions and collections used in this list are: AMNH (American Museum of Natural History), BC (private collection of the late Sherman C. Bishop), BMNH (British Museum, Natural History), BSP (Bureau of Science, Philippines), BYU (Brigham Young University), CNHM (Chicago Natural History Museum), ChM (Charleston Museum), IB (Instituto Butantan, São Paulo), KU (Kansas University), LMK (L. M. Klauber Collection), MBUCV (Museo de Biología, Universidad Central de Venezuela, Caracas), MCZ (Museum of Comparative Zoology), MST (Museo Santo Tomas, Manila), SU (Stanford University), UCM (University of Colorado Museum), UF (University of Florida), UIMNH (University of Illinois Museum of Natural History), UMMZ (University of Michigan Museum of Zoology), USNM (United States National Museum), and WCAB (Werner C. A. Bokermann Collection).

We are indebted to M. Graham Netting and Kenneth C. Parkes for critical advice, and to Arthur V. Bianculli, assistant in the Section of Amphibians and Reptiles, without whose capable assistance this work would have taken much longer. This list records all type-specimens catalogued to June 30, 1965.

#### Order GYMNOPIHONA

*Scolecomorphus kirkii ulugurensis* Barbour and Loveridge; see *Scolecomorphus ulugurensis* Barbour and Loveridge.

*Scolecomorphus ulugurensis* Barbour and Loveridge, 1928, Mem. Mus. Comp. Zool., 50: 180, -type in MCZ. *Scolecomorphus kirkii ulugurensis* Barbour and Loveridge, according to Loveridge, 1957, Bull. Mus. Zool., 117: 307.

PARATYPES: 8694: Tanganyika, Uluguru Mountains, Nyingwa; A. Loveridge; 16 Oct. 1926 (MCZ 12292). 8695: same locality and collector; 19 Oct. 1926 (MCZ 12293).

### Order CAUDATA

**Ambystoma cingulatum bishopi** Goin, 1950, Ann. Carnegie Mus., 31: 300.

HOLOTYPE: 29137: Florida, Escambia Co., about 5 mi. N Pensacola; H. E. Nygren; 7 May 1949.

PARATYPES: 29138: all same locality and collector as holotype; 15 Apr. 1949. 29139-40: 7 May 1949. 29141-43: 6 June 1949. 29144: 10 Sept. 1949.

**Ambystoma granuloseum** Taylor, 1944, Univ. Kansas Sci. Bull., 30: 57, -type in CNHM.

PARATYPE: 39980: Mexico, Mexico, km. 70-74, 10-12 mi. NW Toluca; E. H. Taylor and H. M. Smith; 1940 (UIMNH 22831).

**Ambystoma ordinaria** Taylor, 1940, Univ. Kansas Sci. Bull., 26: 422, -type in CNHM.

PARATYPE: 39982: Mexico, Michoacan, 4 mi. W El Mirador, near Puerto Hondo, 9000 ft.; E. H. Taylor; 2-3 Sept. 1938 (UIMNH 27314).

**Ambystoma subsalsum** Taylor, 1943, Copeia: 152, -type in CNHM.

PARATYPE: 39981: Mexico, Puebla, Lake Alchichica; E. H. Taylor and D. McH. Forbes; 14-15 Aug. 1943 (UIMNH 27325).

**Aneides flavipunctatus niger** Myers and Maslin, 1948, Proc. Biol. Soc. Washington, 61: 132, -type in SU.

PARATYPE: 40000: California, Santa Clara Co., Congress Springs, 1.3 mi. W Saratoga; T. P. Maslin and W. F. Wood; 10 Mar. 1940 (UCM 1558).

**Bolitoglossa dimidiata** Taylor, 1940, Univ. Kansas Sci. Bull., 26: 408, -type in CNHM. *Chiropterotriton dimidiatus* (Taylor), according to Taylor, 1944, Univ. Kansas Sci. Bull., 30: 216.

PARATYPE: 39984: Mexico, Hidalgo, El Chico National Park, 2660-3300 m.; E. H. Taylor; 1938 (UIMNH 27068).

**Bolitoglossa engelhardti** (Schmidt); see *Oedipus engelhardti* Schmidt.

**Bolitoglossa laevis** Taylor, 1942, Univ. Kansas Sci. Bull., 28: 295, -type in CNHM. *Chiropterotriton laevis* (Taylor), according to Taylor, 1944, Univ. Kansas Sci. Bull., 30: 216.

PARATYPE: 39983: Mexico, Veracruz, 2 mi. W La Joya; E. H. Taylor, D. McH. Forbes, and G. Garcia; 16 Aug. 1941 (UIMNH 27101).

**Bolitoglossa orestes** Brame and Wake, 1962, Copeia: 171, -type in BMNH.

PARATYPE: 10086: Venezuela, Merida, Merida; Rosenberg; date unknown.

**Bolitoglossa terrestris** Taylor, 1941, Univ. Kansas Sci. Bull., 27: 115, -type in CNHM. *Chiropterotriton chondrostega terrestris* (Taylor), according to Rabb, 1958, Occas. Papers Mus. Zool. Univ. Michigan, 587: 23.

PARATYPES: 39985-86: Mexico, Hidalgo, 4-10 mi. S Tianguistengo; R. C. and E. H. Taylor; 1-2 July 1940 (UIMNH 26923-24).

**Bolitoglossa xolocalcae** Taylor, 1941, Univ. Kansas Sci. Bull., 27: 148, -type in USNM. *Chiropterotriton xolocalcae* (Taylor), according to Taylor, 1944, Univ. Kansas Sci. Bull., 30: 216.

PARATYPES: 39987-88: Mexico, Chiapas, Cerro Ovando, 6800-8000 ft.; R. and H. M. Smith; 16 Apr. 1940 (UIMNH 27203-04).

*Chiropterotriton dimidiatus* (Taylor); see **Bolitoglossa dimidiata** Taylor.

*Chiropterotriton* larvae (Taylor); see **Bolitoglossa** larvae Taylor.

*Chiropterotriton multidentatus* (Taylor); see **Oedipus multidentata** Taylor.

*Chiropterotriton nasalis* (Dunn); see **Oedipus nasalis** Dunn.

*Chiropterotriton chondrostega terrestris* (Taylor); see **Bolitoglossa terrestris** Taylor.

*Chiropterotriton xolocalcae* (Taylor); see **Bolitoglossa xolocalcae** Taylor.

**Desmognathus aeneus** Brown and Bishop, 1947, Copeia: 163, -type in USNM. *Desmognathus aeneus aeneus* Brown and Bishop.

PARATYPE: 27105: North Carolina, Cherokee Co., 0.5 mi. SSE Peachtree; J. C. Nicholls, Jr., 22 Oct. 1946.

**Desmognathus aeneus chermocki** Bishop and Valentine; see **Desmognathus chermocki** Bishop and Valentine.

**Desmognathus chermocki** Bishop and Valentine, 1950, Copeia: 39, -type in CNHM. *Desmognathus aeneus chermocki* Bishop and Valentine, according to Chermock, 1952, Geol. Surv. Alabama, Mus. Papers, 33: 29.

PARATYPES: 29157-58: Alabama, Tuscaloosa Co., Hurricane Creek; R. L. Chermock, B. O. Valentine, and J. C. Nicholls, Jr.; 30 Mar. 1948.

**Desmognathus fuscus welteri** Barbour, 1950, Copeia: 277, -type in USNM.

PARATYPES: 29121-36: Kentucky, Harlan Co., Big Black Mountain, 4100 ft.; R. W. Barbour; 13 June 1948.

**Desmognathus ocoee** Nicholls, 1949, Jour. Tennessee Acad. Sci., 24: 127, -type in USNM.

PARATYPES: 29290-91: Tennessee, Polk Co., 9 mi. WNW Ducktown; J. C. Nicholls, Jr.; 14 Nov. 1948.

**Diemictylus perstriatus** (Bishop); see *Triturus perstriatus* Bishop.

**Diemictylus viridescens evergladensis** Peterson, 1952, Herpetologica, 8: 103, -type in UIMNH. *Diemictylus viridescens piaropicola* Schwartz and Duellman, according to Neill, 1954, Publ. Res. Div. Ross Allen's Reptile Inst., 1: 79.

PARATYPES: 39989-90: Florida, Dade Co., 26 mi. W Miami; H. W. Peterson; 1 May 1952 (UIMNH 30493-94).

**Eurycea aquatica** Rose and Bush, 1963, Tulane Studies Zool., 10: 121, -type in USNM.

PARATYPES: 38647-48: Alabama, Jefferson Co., 2 mi. W Bessemer; F. L. Rose, F. M. Bush, and J. Jackson; 6 Oct. 1962.

**Eurycea bislineata rivicola** Mittleman, 1949, Proc. Biol. Soc. Washington, 62: 93, -type in USNM.

PARATYPES: 39992: Kentucky, Carter Co., Carter Cave; collector and date unknown (UIMNH 34562). 39993: Kentucky, Carter Co., Cascade Cave; M. B. Mittleman; 13 May 1939 (UIMNH 34563).

**Eurycea bislineata wilderae** Dunn, 1920, Proc. Biol. Soc. Washington, 33: 134, -type in MCZ.

PARATYPE: 20524: North Carolina, Avery Co., Linville; E. R. Dunn; July, 1919 (MCZ 5857).



**Eurycea griseogaster** Moore and Hughes, 1941, Copeia: 139, -type in CNHM. *Eurycea multiplicata griseogaster* Moore and Hughes, according to Schmidt, 1953, "Check list of North American amphibians and reptiles," p. 55.

PARATYPES: 20080-81, 20082 (6 specimens): Oklahoma, Sequoyah Co., Swimmer's Creek, 10 mi. NE Gore; A. Seamster and G. A. Moore; 11 Apr. 1941.

**Eurycea longicauda pernix** Mittleman, 1942, Proc. New England Zool. Club, 21: 101, -type in MCZ. *Eurycea longicauda longicauda* (Green), according to Smith, 1961, Illinois Nat. Hist. Surv. Bull., 28: 44.

PARATYPE: 39991: Indiana, Brown Co., Jimmie Strahl Creek, Brown County State Park, 2.5 mi. SE Nashville; M. E. and M. B. Mittleman; 22 Aug. 1942 (UIMNH 20672).

**Eurycea multiplicata griseogaster** Moore and Hughes; see **Eurycea griseogaster** Moore and Hughes.

**Eurycea nana** Bishop, 1941, Occas. Papers Mus. Zool. Univ. Michigan, 451: 6, -type in UMMZ.

PARATYPES: 22077-78: Texas, Hays Co., lake at the head of the San Marcos River, San Marcos; C. E. Mohr; 22 June 1938.

**Eurycea neotenes** Bishop and Wright, 1937, Proc. Biol. Soc. Washington, 50: 142, -type in USNM.

PARATYPE: 22076: Texas, Bexar Co., Culebra Creek, 5 mi. N Helotes; S. C. Bishop and M. R. Wright; 1 Apr. 1936.

**Eurycea tynerensis** Moore and Hughes, 1939, Amer. Midland Nat., 22: 697, -type not designated.

SYNTYPE: 18525: Oklahoma, Adair Co., Tyner Creek, 0.5 mi. E Proctor; J. D. Mizelle and G. A. Moore; 29 May 1939.

**Gyrinophilus danielsi dunni** Mittleman and Jopson; see **Gyrinophilus dunni** Mittleman and Jopson.

**Gyrinophilus dunni** Mittleman and Jopson, 1941, Smithsonian Misc. Coll., 101: 2, -type in USNM. *Gyrinophilus danielsi dunni* Mittleman and Jopson, according to Bishop, 1943, "Handbook of Salamanders," p. 365.

PARATYPE: 21017: South Carolina, Pickens Co., Clemson College, 700 ft.; O. L. Cartwright; 19 Nov. 1926.

*Gyrinophilus porphyriticus duryi* (Weller); see *Pseudotriton duryi* Weller.

*Gyrinophilus porphyriticus inagnoscus* Mittleman, 1942, Proc. New England Zool. Club, 20: 27, -type in USNM.

PARATYPE: 39994: Ohio, Washington Co., Squaw Hollow, Marietta; Eggles-ton; Apr., 1936 (UIMNH 36175).

*Necturus lewisi* Brimley; see *Necturus maculosus lewisi* Brimley.

*Necturus maculosus lewisi* Brimley, 1924, Jour. Elisha Mitchell Sci. Soc., 11: 167, -type in USNM. *Necturus lewisi* Brimley, according to Vios-ca, 1937, Copeia: 124.

PARATYPE: 10594: North Carolina, Wake Co., Neuse River, Raleigh; F. B. Lewis; 16 May 1917 (MCZ 17728).

*Necturus maculosus stictus* Bishop, 1941, Occas. Papers Mus. Zool. Univ. Michigan, 451: 9, -type in UMMZ.

PARATYPE: 22074: Wisconsin, Winnebago Co., Lake Winnebago; J. Pawlack; 1 Apr. 1941.

*Oedipus engelhardti* Schmidt, 1936, Field Mus. Nat. Hist., zool. ser., 20: 156, -type in CNHM. *Bolitoglossa engelhardti* (Schmidt), ac-cording to Wake and Brame, 1963, Copeia: 386.

PARATYPES: 9305-06: Guatemala, Solola, Volcan Atitlan, 7000 ft. above Olas de Moca; F. J. W. Schmidt; 9 Mar. 1934 (CNHM 20408).

*Oedipus multidentata* Taylor, 1939, Univ. Kansas Sci. Bull., 25: 289, -type in MCZ. *Chiropterotriton multidentatus* (Taylor), ac-cording to Taylor, 1944, Univ. Kansas Sci. Bull., 30: 216.

PARATYPES: 39995-96: Mexico, Hidalgo, El Chico National Park; E. H. Taylor; 2 Aug. 1938 (UIMNH 26979-80).

*Oedipus nasalis* Dunn, 1924, Field Mus. Nat. Hist., zool. ser., 12: 97, -type in CNHM. *Chiropterotriton nasalis* (Dunn), according to Taylor, 1944, Univ. Kansas Sci. Bull., 30: 216.

PARATYPE: 9307: Honduras, mountains W San Pedro, 4500 ft.; K. P. Schmidt and L. L. Walters; May, 1923 (CNHM 4588).

*Plethodon cinereus angusticlavius* Grobman, 1944, Ann. New York Acad. Sci., 45: 302, -type in AMNH. *Plethodon dorsalis angusticla-vius* Grobman, according to Thurow, 1956, Herpetologica, 12: 177.

PARATYPE: 21960: Arkansas, Crawford Co., The Narrows, 3 mi. S Locke; B. C. Marshall; 24 Dec. 1936.

**Plethodon cinereus serratus** Grobman, 1944, Ann. New York Acad. Sci., 45: 306, -type in CNHM.

PARATYPE: 21961: Arkansas, Yell Co., Mount Nebo, 6 mi. W Dardanelle; B. C. Marshall; 6 Mar. 1936.

**Plethodon dorsalis angusticlavius** Grobman; see **Plethodon cinereus angusticlavius** Grobman.

**Plethodon glutinosus albagula** Grobman, 1944, Ann. New York Acad. Sci., 45: 283.

HOLOTYPE: 9652: Texas, Bexar Co., Classen's Ranch, 20 mi. N San Antonio; W. Clanton; 24 Feb. 1935.

PARATYPES: 9651, 9653-63: same data as holotype. 21946-47, 21954-59: Texas, Hays Co., San Marcos; B. C. Marshall; Apr., 1929. 21950-53: same locality and collector; Mar., 1929.

**Plethodon huldae** Grobman, 1949, Proc. Biol. Soc. Washington, 62: 136, -type in USNM. *Plethodon cinereus cinereus* (Green), according to Rabb, 1955, Copeia: 262.

PARATYPES: 28897-99: Virginia, Madison Co., foot trail to Hawksbill Mountain, 1100 yards from Skyline Drive; R. L. Hoffman, H. I. Kleinpeter, and A. B. Grobman; 7 Aug. 1947.

**Plethodon longicrus** Adler and Dennis, 1962, Ohio Herp. Soc., Special Publ., 4: 1, -type in USNM.

PARATYPES: 38009: North Carolina, Rutherford Co., northeast slope of Blue-rock Mountain, 0.8 mi. ESE Bat Cave (city); K. K. Adler, D. M. Dennis, and S. G. Tilley; 28 Aug. 1961. 38010: same locality; K. K. Adler, D. M. Dennis, and C. J. Hirschfeld; 7-8 Sept. 1961.

**Plethodon nettingi** Green, 1938, Ann. Carnegie Mus., 27: 295. *Plethodon richmondi nettingi* Green, according to Highton and Grobman, 1956, Herpetologica, 12: 187.

HOLOTYPE: 10279: West Virginia, Randolph Co., Barton Knob, near Cheat Bridge, 4400 ft.; M. G. Netting; 29 June 1935.

PARATYPES: 11810-11, 11813-14: West Virginia, Randolph Co., 0.25 mi. SE Cheat Bridge; N. D. Richmond; 15 July 1936. 11900: West Virginia, Randolph Co., Barton Knob, near Cheat Bridge; M. Brooks and C. Lewis; 25 Aug.-4 Sept. 1936.

**Plethodon ouachitae** Dunn and Heinze, 1933, Copeia: 121, -type in USNM.

PARATYPE: 7141: Oklahoma, Le Flore Co., Page; L. Hubricht; 1 May 1933.

**Plethodon richmondi** Netting and Mittleman, 1938, Ann. Carnegie Mus., 27: 288. *Plethodon richmondi richmondi* Netting and Mittleman.

HOLOTYPE: 14189: West Virginia, Cabell Co., Ritter Park, Huntington; N. D. Richmond and N. B. Green; 15 Oct. 1938.

PARATYPES: 5278-79, 5285 (4 specimens), 5294, 5303-08, 5985-86, 8775: West Virginia, Ohio Co., Oglebay Park, near Wheeling; M. G. Netting; various dates. 5599: West Virginia, Marion Co.; R. F. Martin; June-July, 1931. 6079: West Virginia, Wayne Co., 3 mi. S Wayne; N. D. Richmond; 28 Oct. 1932. 6097: West Virginia, Lewis Co., near Weston; P. J. Zuccherro; about 1932. 7515, 9773: West Virginia, Lewis Co., Jane Lew; J. D. Neill; 1934-1935. 11256: West Virginia, Upshur Co., French Creek; M. Brooks and C. Lewis; 8-11 Aug. 1936. 14190-215: same data as holotype. 14258 (40 specimens), 14264 (11 specimens), 14265-68: West Virginia, Cabell Co., Pleasant Valley, 2 mi. S Huntington; N. D. Richmond; 22 and 31 Oct. 1938. 14271: West Virginia, Cabell Co., Enslow Park, Huntington; N. D. Richmond; 9 Nov. 1938. 14102-04: Ohio, Lawrence Co., S of Crown City, 3 mi. from Gallia County line; N. D. Richmond; 26 Apr. 1938.

**Plethodon richmondi nettingi** Green; see **Plethodon nettingi** Green.

**Plethodon richmondi popei** Highton and Grobman, 1956, Herpetologica, 12: 187, -type in UF. *Plethodon richmondi richmondi* Netting and Mittleman, according to Highton, 1962, Bull. Florida State Mus., 6: 305.

PARATYPES: 34063-64; Virginia, Grayson-Wythe County line, Comers Rock; W. Auffenberg and A. B. Grobman; 30 Aug. 1951.

**Plethodon stormi** Highton and Brame, 1965, Pilot Register Zool., no. 20, -type in USNM.

PARATYPE: 39919: Oregon, Jackson Co., 0.3 mi. S McKee Bridge; R. M. Storm; 22 Mar. 1964.

**Plethodon welleri** Walker, 1931, Proc. Junior Soc. Nat. Sci. (Cincinnati), 2: 48, -type in USNM.

PARATYPE: 10994: North Carolina, Avery Co., Grandfather Mountain, near Linville; W. H. Weller and R. Dury; 27 Aug. 1930.

**Pseudobranchius striatus axanthus** Netting and Goin, 1942, Ann. Carnegie Mus., 29: 183.

HOLOTYPE: 20339: Florida, Alachua Co., Payne's Prairie, 5 mi. SE Gainesville; C. J. Goin; 9 Feb. 1940.

PARATYPES: 6171-72: same locality as holotype; G. W. Van Hyning; 11 Nov. 1932. 9399 (18 specimens): same locality; W. Clanton; 15 Jan. 1935. 20130 (44 specimens): same locality; C. J. Goin; 9 Feb. 1940. 20132: same locality and collector; 22 Sept. 1939. 10998-99: Florida, Alachua Co., Gainesville; collector unknown;

Oct., 1932. **12175-76**: Florida, Alachua Co., Lochloosa Lake, near Lochloosa; C. J. Goin; 1 Feb. 1937. **20131** (21 specimens): Florida, Alachua Co., River Styx, 5 mi. SE Gainesville; C. J. Goin; 29 Feb. 1940.

**Pseudobranchius striatus spheniscus** Goin and Crenshaw, 1949, Ann. Carnegie Mus., 31: 277.

HOLOTYPE: **29015**: Georgia, Lee Co., 7 mi. S Smithville; G. B. Rabb and J. E. Mosimann; 4 July 1948.

PARATYPES: **20160** (2 specimens): Florida, Liberty Co., 5.4 mi. S Telogia; H. H. Hobbs, Jr.; 2 May 1941. **21440-41**: Florida, Columbia Co., 30 mi. N Lake City; H. H. Hobbs, Jr.; 2 Sept. 1941. **21466**: Florida, Gulf Co., 12.2 mi. W Wewahatchka; C. J. Goin; 9 Apr. 1942.

**Pseudotriton duryi** Weller, 1930, Proc. Junior Soc. Nat. Sci. (Cincinnati), 1: 7, -type in USNM. *Gyrinophilus porphyriticus duryi* (Weller), according to Stejneger and Barbour, 1933, "Check list of North American amphibians and reptiles," ed. 3, p. 15.

PARATYPE: **10937**: Kentucky, Carter Co., Cascade Cave, near Grayson; W. H. Weller, et al; 6 Apr. 1930.

**Pseudotriton montanus diastictus** Bishop, 1941, Occas. Papers Mus. Zool. Univ. Michigan, 451: 14, -type in BC.

PARATYPES: **7459**: West Virginia, Kanawha Co., Holly Grove (Hudnall); Sweadner and Chermock; 1933. **10615**: West Virginia, Cabell Co., Huntington; F. A. Gilbert; 5 May 1936. **13000**: West Virginia, Mercer Co., near Athens; P. C. Bibbee; date unknown. **15399**: West Virginia, Mercer Co., Bluefield; N. B. Green; July, 1931. **15400**: West Virginia, Mercer Co., Grassy Branch, near Bluefield; A. H. Wright; 14 Apr. 1930. **17482**: West Virginia, Cabell Co., Ritter Park, Huntington; N. D. Richmond; 16 Oct. 1938. **17577**: West Virginia, Wayne Co., near Buffalo; R. Malcomb; 1938. **18082**: West Virginia, Lincoln Co., Branchland; M. Thacker; 1939. **19238**: West Virginia, Kanawha Co., Big Indian Cave, Hudnall; C. B. Wurtz; 19 June 1938. **19401**: West Virginia, Cabell Co., Roland Park, Huntington; N. B. Green; 24 Apr. 1940. **19407**: West Virginia, Cabell Co., Merrick Creek; N. B. Green; 30 Sept. 1939. **19448**: West Virginia, Putnam Co., Hurricane; N. B. Green; 9 July 1940. **16967**: Kentucky, Laurel Co., near Little Laurel River; N. Mullens; 8 Mar. 1939. **17575**: Kentucky, Boyd Co., Cattleburg; T. McCoy; 8 Apr. 1937.

**Pseudotriton montanus floridanus** Netting and Goin, 1942, Ann. Carnegie Mus., 29: 175.

HOLOTYPE: **16850**: Florida, Alachua Co., Gainesville; A. F. Carr, Jr.; 19 Apr. 1936.

PARATYPES: **16851-53**: same data as holotype. **20129**: Florida, Alachua Co., 4 mi. E Gainesville; A. Laessle; 31 Jan. 1941.

**Pseudotriton ruber vioscai** Bishop, 1928, Occas. Papers Boston Soc. Nat. Hist., 5: 247, -type in USNM.



PARATYPE: 16835: Louisiana, Washington Parish, 10 mi. W. Bogalusa; P. Viosca, Jr.; 10 Apr. 1926.

**Siren intermedia nettingi** Goin, 1942, Ann. Carnegie Mus., 29: 211.

HOLOTYPE: 7580: Arkansas, Lawrence Co., Imboden; B. C. Marshall; May, 1928.

PARATYPES: 7581: same data as holotype. 19078-81: Illinois, Perry Co., 5 mi. E. DuQuoin; E. L. Cockrum; 5 Feb. 1939. 20142, 20144-55: Louisiana, Rapides Parish, Beechwood Fish Hatchery, Forest Hill; P. Viosca, Jr.; Jan., 1941.

**Thorius narisovalis** Taylor, 1940, Univ. Kansas Sci. Bull., 26: 416, -type in CNHM.

PARATYPE: 39997: Mexico, Oaxaca, Cerro San Felipe, 15 km. N Oaxaca; 2600-3000 m.; E. H. Taylor; 18-22 Aug. 1938 (UIMNH 26850).

**Thorius pulmonaris** Taylor, 1940, Univ. Kansas Sci. Bull., 26: 411, -type in CNHM.

PARATYPE: 39998: Mexico, Oaxaca, Cerro San Felipe, 12 km. N Oaxaca; E. H. Taylor, et al; 18-22 Aug. 1938 (UIMNH 30999).

**Triturus granulosis twittyi** Bishop, 1941, Occas. Papers Mus. Zool. Univ. Michigan, 451: 16, -type in UMMZ. *Taricha granulosa granulosa* (Skilton), according to Riemer, 1958, Univ. California Publ. Zool., 56: 385-386.

PARATYPE: 22075: California, Santa Clara Co., Saratoga; V. C. Twitty, M. R. Wright, and S. C. Bishop; 20 May 1936.

**Triturus perstriatus** Bishop, 1941, Occas. Papers Mus. Zool. Univ. Michigan, 451: 3, -type in UMMZ. *Diemictylus perstriatus* (Bishop), according to Neill, 1954, Publ. Res. Div. Ross Allen's Reptile Inst., 1: 79.

PARATYPES: 21735-39, 39877-78, 39880-81: Florida, Alachua Co., pond at Sugarfoot; H. K. Wallace and A. F. Carr, Jr.; 14 Feb. 1933 (UF 43).

## Order SALIENTIA

**Acris crepitans blanchardi** Harper; see *Acris gryllus blanchardi* Harper.

**Acris gryllus blanchardi** Harper, 1947, Proc. Biol. Soc. Washington, 60:39. *Acris crepitans blanchardi* Harper. Although Viosca presented convincing evidence for the recognition of *Acris crepitans* Baird as long ago as 1923 (Copeia, 115: 9), it has been ignored by numerous au-

thors including Harper (op. cit.). This problem is summarized by Neill, 1954, Publ. Res. Div. Ross Allen's Reptile Inst., 1: 81-82.

HOLOTYPE: 26607: Missouri, Christian Co., meadow near Smallen's Cave, Ozark; C. E. Mohr; 9 June 1938. [Catalogue number 26607 was supplied to Harper to affix to the specimen cited here as holotype; the specimen was never received at Carnegie Museum and is presumed lost.]

**Bufo boreas exsul** Myers; see **Bufo exsul** Myers.

**Bufo exsul** Myers, 1942, Occas. Papers Mus. Zool. Univ. Michigan, 460: 3, -type in UMMZ. *Bufo boreas exsul* Myers, according to Stebbins, 1951, "Amphibians of Western North America," pp. 234-245.

PARATYPES: 13038-39: California, Inyo Co., Deep Springs Valley, Deep Springs; G. F. Ferris, I. L. Wiggins, and G. S. Myers; 1 May 1937.

**Bufo houstonensis** Sanders, 1953, Herpetologica, 9: 27, -type in UIMNH.

PARATYPES: 32688-90: Texas, Harris Co., Fairbanks; J. C. Wottring and W. J. Greer; 18 May 1952.

**Bufo quechua** Gallardo, 1961, Breviora, 141: 4.

HOLOTYPE: 4225: Bolivia, Cochabamba, Incachaca, 2500 m.; J. Steinbach; date unknown.

PARATYPES: 4223-24, 4226: same data as holotype.

**Bufo woodhousei velatus** Bragg and Sanders, 1951, Wasmann Jour. Biol., 9: 366, -type in USNM.

PARATYPES: 32685-87: Texas, Anderson Co., Elkhart; O. and R. M. Sanders; 8 Mar. 1951.

**Chaperina beyeri** Taylor, 1920, Philippine Jour. Sci., 16: 333. *Chaperina fusca* Mocquard, according to Inger, 1954, Fieldiana, Zoology, 33: 414.

HOLOTYPE: 3312: Philippines, Mindanao, between Agusan and Simulao Rivers; E. H. Taylor; June, 1913.

PARATYPES: 3306-07, 3309-10, 3314-18, 3426: same data as holotype.

**Cornufer hazelae** (Taylor); see **Philautus hazelae** Taylor.

**Cornufer ingeri** Brown and Alcala, 1963, Copeia: 672, -type in SU.

PARATYPE: 38912: Philippines, Bohol, Dusita area, about 13 km. SE Sierra Bullones; A. C. Alcala, et al; Apr.-May, 1962 (SU 21714).

*Cornufer laticeps* Taylor, 1920, Philippine Jour. Sci., 16: 317.  
*Cornufer dorsalis* A. Duméril, according to Brown and Inger, 1964, Copeia: 451.

HOLOTYPE: 3496: Philippines, Mindanao, Bunawan; E. H. Taylor; Sept., 1912.

PARATYPES: 3497-3500: same data as holotype.

*Dendrobates minutus ventrimaculatus* Shreve, 1935, Occas. Papers Boston Soc. Nat. Hist., 8: 213, -type in MCZ.

PARATYPE: 10607: Ecuador, along the Pastaza River from Canelos to the Marañón River; C. Spencer; 1932.

*Eleutherodactylus bakeri heminota* Shreve and Williams, 1963, Bull. Mus. Comp. Zool., 129: 325, -type in MCZ.

PARATYPES: 37781-85: Haiti, Furcy; L. Whiteman; 17 Mar. 1961.

*Eleutherodactylus ricordi rogersi* Goin, 1955, Amer. Mus. Novitates, 1708: 1, -type in AMNH.

PARATYPES: 20452-53: Bahamas, San Salvador; G. R. Campbell; June, 1941.

*Eleutherodactylus yucatanensis* Lynch, 1965, Herpetologica, 20: 249, -type in KU.

PARATYPE: 36444: Mexico, Yucatan, near Chichen Itza; J. Dolan; 20 June 1958.

*Engystomops pustulosus ruthveni* (Netting); see *Eupemphix ruthveni* Netting.

*Eupemphix ruthveni* Netting, 1930, Ann. Carnegie Mus., 19: 167, -type in UMMZ. *Engystomops pustulosus ruthveni* (Netting), according to Dunn, 1944, Caldasia, 2: 512.

PARATYPE: 5455: Colombia, Santa Marta Mountains, between Mamatoco and La Tigrera; A. G. Ruthven; 28 July 1913 (UMMZ 45486).

*Hazelia spinosa* Taylor, 1920, Philippine Jour. Sci., 16: 292. *Philautus spinosus* (Taylor), according to Inger, 1954, Fieldiana, Zoology, 33: 407.

HOLOTYPE: 3420: Philippines, Mindanao, Bunawan; E. H. Taylor; Aug., 1912.

*Hyla microeximia* Maslin, 1957, Herpetologica, 13: 81, -type in USNM. *Hyla eximia* Baird, according to Bogert, 1960, Amer. Inst. Biol. Sci., publ. 7: 199.

PARATYPE: 40001: Mexico, Jalisco, 3 mi. NW Jocotepec; T. P. Maslin; 20 June 1956 (UCM 8383).

**Hyloxalus panamansis** Dunn, 1933, Occas. Papers Boston Soc. Nat. Hist., 8: 69, -type in MCZ. *Prostherapis inguinalis* Cope, according to Dunn, 1957, Copeia: 77.

PARATYPES: 7142-43: Panama, Panama, El Valle de Anton; E. R. Dunn; 5-12 Aug. 1932.

**Hyperolius ahli** Loveridge, 1936, Bull. Mus. Comp. Zool., 79: 402, -type in MCZ. *Hyperolius argus ahli* Loveridge, according to Loveridge, 1957, Bull. Mus. Comp. Zool., 117: 331.

PARATYPE: 18539: Kenya, Witu, near Lake Peccatoni; A. Loveridge; 31 May 1934.

**Hyperolius argus ahli** Loveridge; see **Hyperolius ahli** Loveridge.

**Megalophrys ligayae** Taylor, 1920, Philippine Jour. Sci., 16: 350. *Megophrys monticola ligayae* (Taylor), according to Inger, 1954, Fieldiana, Zoology, 33: 224.

HOLOTYPE: 3304: Philippines, northern Palawan; V. Lednicky; May, 1917.

PARATYPE: 3305: same data as holotype.

**Megalophrys stejnegeri** Taylor, 1920, Philippine Jour. Sci., 16: 347. *Megophrys monticola stejnegeri* (Taylor), according to Inger, 1954, Fieldiana, Zoology, 33: 224.

HOLOTYPE: 3394: Philippines, Mindanao, Bunawan; E. H. Taylor; 10 Aug. 1912.

PARATYPES: 3301-03, 3395, 3398-99: same data as holotype.

**Megophrys monticola ligayae** (Taylor); see **Megalophrys ligayae** Taylor.

**Megophrys monticola stejnegeri** (Taylor); see **Megalophrys stejnegeri** Taylor.

**Philautus hazelae** Taylor, 1920, Philippine Jour. Sci., 16: 298. *Cornufer hazelae* (Taylor), according to Inger, 1954, Fieldiana, Zoology, 33: 367.

HOLOTYPE: 3427: Philippines, Negros, Canlaon Volcano, about 1000 m.; E. H. Taylor; 25 Dec. 1915.

PARATYPES: 3428-29, 3432-36: same data as holotype.

**Philautus spinosus** (Taylor); see **Hazelia spinosa** Taylor.

**Phyllomedusa pailona** Shreve, 1959, Breviora, 113: 1, -type in MCZ.

PARATYPES: 36278-79: Bolivia, Santa Cruz, El Pailon; C. Gans and F. S. Pereira; 5 Mar. 1954.

**Physalaemus centralis** Bokermann, 1962, Rev. Bras. Biol., 22: 216, -type in WCAB.

PARATYPES: 39901-02: Brazil, Mato Grosso, Xingu (Posto Yacare), Rio Coluene; W. C. A. Bokermann and M. Alvarenga; 5 Nov. 1961.

**Pseudacris nigrita kalmi** Harper, 1955, Chicago Acad. Sci., Nat. Hist. Misc., 150: 1. *Pseudacris triseriata kalmi* Harper, according to Schwartz, 1957, Amer. Mus. Novitates, 1838: 11.

HOLOTYPE: 33917: New Jersey, Burlington Co., Centreton, 5 mi. NE Moorestown; R. Conant and J. M. Cadbury; 19 Mar. 1936.

PARATYPES: 38053-57: Pennsylvania, Bucks Co., 1 mi. E Tullytown; R. Conant; 28 Apr. 1939. 38058 (15 specimens): Pennsylvania, Montgomery Co., Unami Valley, near Sumneytown; R. Conant and N. Wolff; 5 Apr. 1942.

**Pseudacris triseriata kalmi** Harper; see **Pseudacris nigrita kalmi** Harper.

**Pseudis paradoxa caribensis** Gallardo, 1961, Bull. Mus. Comp. Zool., 125: 116, -type in MCZ.

PARATYPE: 33787: Trinidad, pond at Mayaro; C. Gans; 22 Sept. 1953.

**Rana albolabris adiscifera** Schmidt and Inger, 1959, Inst. Parcs Nationaux Congo Belge, Exploration Parc National de l'Upemba, fasc. 56: 48, -type in CNHM. *Hylarana darlingi* (Boulenger), according to Poynton, 1964, Ann. Natal Mus., 17: 120.

PARATYPES: 6754, 6756, 6788: Angola, Bihe, Chitau; R. and L. Boulton; 12 Jan. 1931.

**Rana areolata sevos**a Goin and Netting; see **Rana sevos**a Goin and Netting.

**Rana capito stertens** Schwartz and Harrison, 1956, Proc. Biol. Soc. Washington, 69: 136, -type in ChM. *Rana areolata capito* LeConte, according to Neill, 1957, Herpetologica, 13: 52.

PARATYPES: 34060-61: South Carolina, Berkeley Co., 6 mi. N Cainhoy; J. R. Harrison, J. A. Quinby, and A. Schwartz; 4 Sept. 1955.

**Rana grandocula** Taylor, 1920, Philippine Jour. Sci., 16: 274. *Rana signata grandocula* Taylor, according to Inger, 1954, Fieldiana, Zoology, 33: 322.

HOLOTYPE: 3501: Philippines, Mindanao, Bunawan; E. H. Taylor; Aug., 1912.

PARATYPES: 3502-05: same data as holotype.



**Rana guerreroi** Taylor, 1920, Philippine Jour. Sci., 16: 255, -type location unknown. *Rana everetti luzonensis* Boulenger, according to Inger, 1954, Fieldiana, Zoology, 33: 311.

PARATYPES: 3271, 3273-78, 3280-81, 3283, 3323-25: Philippines, Luzon, Baguio; E. H. Taylor; May, 1915.

**Rana moodiei** Taylor, 1920, Philippine Jour. Sci., 16: 234. *Rana cancrivora cancrivora* Gravenhorst, according to Inger, 1954, Fieldiana, Zoology, 33: 260.

HOLOTYPE: 3724: Philippines, Luzon, Manila; E. H. Taylor; Nov., 1914.

**Rana parva** Taylor, 1920, Philippine Jour. Sci., 16: 241.

HOLOTYPE: 3421: Philippines, Mindanao, Bunawan; E. H. Taylor; Aug., 1912.

PARATYPES: 3422-23: same data as holotype.

**Rana philippinensis** Taylor, 1920, Philippine Jour. Sci., 16: 266. *Rana signata grandocula* Taylor, according to Inger, 1954, Fieldiana, Zoology, 33: 322.

HOLOTYPE: 3306: Philippines, Mindanao, Bunawan; E. H. Taylor; 12 Aug. 1913.

**Rana sevos**a Goin and Netting, 1940, Ann. Carnegie Mus., 28: 137. *Rana areolata sevos*a Goin and Netting, according to Viosca, 1949, Louisiana Acad. Sci., Pop. Sci. Bull., 1: 10, and Neill, 1957, Herpetologica, 13: 47-52.

HOLOTYPE: 16809: Louisiana, St. Tammany Parish, Slidell; P. Viosca, Jr.; 11 Apr. 1926.

PARATYPES: 4944, 18184-97: Mississippi, Jackson Co., near Van Cleave; S. Springer; 21 Oct. 1930. 5407-08: Mississippi, Harrison Co., near Biloxi; S. Springer; 3 Apr. 1931.

**Rana signata grandocula** Taylor; see *Rana grandocula* Taylor.

## Order TESTUDINES

**Deirochelys reticularia miaria** Schwartz, 1956, Fieldiana, Zoology, 34: 486, -type in CNHM.

PARATYPES: 5443-45: Texas, Harris Co., Houston; W. A. Bevan; Apr., 1931.

**Pseudemys floridana peninsularis** Carr, 1938, Copeia: 105, -type in MCZ.

PARATYPES: 9875-77: Florida, Pasco Co., Crystal Springs; L. Marchand; 20 Feb. 1938.

*Pseudemys nelsoni* Carr, 1938, Occas. Papers Boston Soc. Nat. Hist., 8: 307, -type in MCZ.

PARATYPES: 12995: Florida, Alachua Co., Gainesville; W. Clanton; 14 Dec. 1932. 12996: same locality; R. E. Bellamy; Apr., 1935.

## Order SQUAMATA

### Suborder SAURIA

*Agama agama dodomae* Loveridge; see *Agama lionotus* var. *dodomae* Loveridge.

*Agama lionotus* var. *dodomae* Loveridge, 1923, Proc. Zool. Soc. London, 944, -type in BMNH. *Agama agama dodomae* Loveridge, according to Loveridge, 1957, Bull. Mus. Comp. Zool., 117: 195.

PARATYPES: 4361-62: Tanganyika, Inkalama, Mtali's; A. Loveridge; 11 Oct. 1922.

*Agama lionotus* var. *mwanzae* Loveridge, 1923, Proc. Zool. Soc. London, 945, -type in BMNH. *Agama planiceps mwanzae* Loveridge, according to Loveridge, 1957, Bull. Mus. Comp. Zool., 117: 195.

PARATYPES: 4363-65: Tanganyika, Mwanza, Shanwa; A. Loveridge; 20 Oct. 1922.

*Agama planiceps mwanzae* Loveridge; see *Agama lionotus* var. *mwanzae* Loveridge.

*Amphisbaena schmidtii* Gans, 1964, Breviora, 198: 3, -type in MCZ.

PARATYPE: 36277: Puerto Rico, Salinas; G. E. Baez; May, 1951.

*Anolis distichus floridanus* Smith and McCauley, 1948, Proc. Biol. Soc. Washington, 61: 160, -type in USNM. *Anolis distichus* Cope, according to Schmidt, 1953, "Check list of North American amphibians and reptiles," p. 237.

PARATYPE: 28217: Florida, Dade Co., Brickell Park, Miami; R. H. McCauley, Jr.; 6 Nov. 1946.

*Anolis equestris palardis* Schwartz, 1964, Bull. Mus. Comp. Zool., 131: 416.

HOLOTYPE: 33320: Cuba, Oriente, Rio Yateras, 5 mi. N river mouth; W. McLane and R. H. Wilkinson; 16 Sept. 1952.

**Anolis steinbachi** Griffin, 1917, Ann. Carnegie Mus., 11: 308. *Norops meridionalis* (Boettger), according to Ernest E. Williams, who has examined the types.

HOLOTYPE: 988: Bolivia, Santa Cruz, Province del Sara, 350 m.; J. Steinbach; Jan., 1912.

PARATYPE: 985: same locality and collector as holotype; Mar., 1912.

**Brachymeles burksi** Taylor, 1917, Philippine Jour. Sci., (D) 12: 275. *Brachymeles bonitae* Duméril and Bibron, according to Brown, 1956, Breviora, 54: 5.

HOLOTYPE: 1975: Philippines, Mindoro, Liddell Plantation, Sumagui; E. H. Taylor; 4 May 1916.

PARATYPES: 1976: Philippines, Mindoro, Calapan; E. H. Taylor; Oct., 1916. 1981, 1984-85: same locality and collector as holotype; 3-10 May 1916.

**Brachymeles elerae** Taylor, 1917, Philippine Jour. Sci., (D) 12: 273, -type in MST.

PARATYPE: 1717: Philippines (no additional data).

**Brachymeles gracilis taylori** Brown, 1956, Breviora, 54: 13, -type in SU.

PARATYPE: 34954: Philippines, Negros, north peak of Cuernos de Negros, 6-8 km. W Luzuriaga; W. C. Brown and Empeso; Feb.-Mar., 1955 (SU 18597).

**Cnemidophorus communis australis** Gadow, 1906, Proc. Zool. Soc. London :352, -type in BMNH. *Cnemidophorus sacki sacki* Weigmann, according to Duellman and Zweifel, 1962, Bull. Amer. Mus. Nat. Hist., 123: 193.

PARATYPE: 8115: Mexico, Oaxaca, Cuicatlan; S. E. Meek; June, 1901 (CNHM 1022).

**Cnemidophorus communis occidentalis** Gadow, 1906, Proc. Zool. Soc. London :339, -type in BMNH. *Cnemidophorus costatus occidentalis* Gadow, according to Zweifel, 1961, Copeia :103.

PARATYPE: 8116: Mexico, Jalisco, Zapotlan; C. M. Barber; date unknown (CNHM 2535).

**Cnemidophorus costatus occidentalis** Gadow; see *Cnemidophorus communis occidentalis* Gadow.

**Cnemidophorus cozumelus rodecki** McCoy and Maslin, 1962, Copeia :624, -type in UCM.

PARATYPE: 40003: Mexico, Quintana Roo, Isla Mujeres; T. P. Maslin, et al; 22 June 1961 (UCM 15369).

**Cnemidophorus gularis meeki** Gadow, 1906, Proc. Zool. Soc. London :332, -type in CNHM. *Cnemidophorus gularis* Baird and Girard, according to Burt, 1931, Bull. U.S. Natl. Mus., 154: 100.

PARATYPE: 8113: Mexico, Nuevo Leon, San Juan; S. E. Meek; 1903 (CNHM 1334).

**Cnemidophorus mexicanus balsas** Gadow, 1906, Proc. Zool. Soc. London :363, -type in BMNH. *Cnemidophorus costatus costatus* Cope, according to Duellman and Zweifel, 1962, Bull. Amer. Mus. Nat. Hist., 123: 179.

PARATYPE: 8114: Mexico, Morelos, Puente de Ixtla; S. E. Meek; June, 1901 (CNHM 1026).

**Cnemidophorus sexlineatus oligoporus** Hoffman, 1957, Jour. Washington Acad. Sci., 47: 153, -type in USNM. *Cnemidophorus sexlineatus* (L.), according to Duellman and Zweifel, 1962, Bull. Amer. Mus. Nat. Hist., 123: 202.

PARATYPE: 5604: Virginia, Nelson Co., Midway Mills; M. G. Netting; 19 Aug. 1931.

**Crotaphytus wislizenii punctatus** Tanner and Banta, 1963, Great Basin Nat., 23: 138, -type in BYU.

PARATYPES: 20765: Utah, Grand Co., Arches National Monument; J. L. Kay; 14 June 1941. 20766: same locality; W. H. Wallace; 13-15 June 1941.

**Cyrtodactylus agusanensis** (Taylor); see *Gymnodactylus agusanensis* Taylor.

**Cyrtodactylus annulatus** (Taylor); see *Gymnodactylus annulatus* Taylor.

**Emoia ruficauda** Taylor, 1915, Philippine Jour. Sci., (D) 10: 98, -type in BSP.

PARATYPES: 1803-05: Philippines, Mindanao, Bunawan; E. H. Taylor; June, 1912.

**Emoia sanfordi** Schmidt and Burt, 1930, Amer. Mus. Novitates, 436: 1, -type in AMNH.

PARATYPE: 8143: New Hebrides, Wala Island; K. P. Schmidt; Mar., 1929 (CNHM 13671).

**Eremias barbouri** Schmidt, 1925, Amer. Mus. Novitates, 175: 2, -type in AMNH. *Eremias argus* Peters, according to Pope, 1929, Bull. Amer. Mus. Nat. Hist., 58: 377.

PARATYPE: 8160: China, Shansi, Mai Tai Chao; C. H. Pope; May, 1922 (CNHM 7385).

**Eumeces septentrionalis pallidus** Smith and Slater, 1949, Trans. Kansas Acad. Sci., 52: 438, -type in UIMNH.

PARATYPE: 8464: Texas, Atascosa Co., 7 mi. SE Lytle; A. J. Kirn; 19 Mar. 1933.

**Gekko mindorensis** Taylor, 1919, Philippine Jour. Sci., 14: 115.

HOLOTYPE: 2098: Philippines, Mindoro, Pocanil Point; E. H. Taylor; 4 May 1916.

PARATYPES: 2100-04: Philippines, Mindoro, Calapan; E. H. Taylor; Dec., 1916.

**Gonatodes hasemani** Griffin, 1917, Ann. Carnegie Mus., 11: 304.

HOLOTYPE: 1040: Bolivia, Villa Bella; J. D. Haseman; 12 Oct. 1909.

PARATYPES: 1041-42: same data as holotype.

**Gymnodactylus agusanensis** Taylor, 1915, Philippine Jour. Sci., (D) 10: 90, -type in BSP. *Cyrtodactylus agusanensis* (Taylor), according to Underwood, 1954, Proc. Zool. Soc. London, 124: 475.

PARATYPES: 1946-48, 1950, 1952: Philippines, Mindanao, Bunawan; E. H. Taylor; June, 1913.

**Gymnodactylus annulatus** Taylor, 1915, Philippine Jour. Sci., (D) 10: 92, -type in BSP. *Cyrtodactylus annulatus* (Taylor) according to Underwood, 1954, Proc. Zool. Soc. London, 124: 475.

PARATYPES: 2483, 2485-500, 2502-03, 2507, 2509-21: Philippines, Mindanao, Bunawan; E. H. Taylor; July, 1913.

**Hemiphyllodactylus insularis** Taylor, 1918, Philippine Jour. Sci., (D) 13: 237.

HOLOTYPE: 2052: Philippines, Mindoro, Sumagui; E. H. Taylor; 20 May 1916.

PARATYPE: 2053: same data as holotype.

**Leiolepisma pulchellum grande** Taylor, 1917, Philippine Jour. Sci., (D) 12: 374. *Lygosoma pulchellum taylori* Brown and Alcalá, 1956, Occas. Papers Mus. Nat. Hist. Stanford, 3: 8 (substitute name).

HOLOTYPE: 2202: Philippines, Negros, Canlaon Volcano; E. H. Taylor; 22 Dec. 1915.

PARATYPE: 2203: same data as holotype.

**Lepidodactylus aureolineatus** Taylor, 1915, Philippine Jour. Sci., (D) 10: 97, -type in BSP.

PARATYPES: 2048-49: Philippines, Mindanao, Bunawan; E. H. Taylor; June, 1913.



**Lepidodactylus christiani** Taylor, 1917, Philippine Jour. Sci., (D) 12: 368.

HOLOTYPE: 1747: Philippines, Negros, Canlaon Volcano, 700 m.; E. H. Taylor; 23 Dec. 1915.

**Lepidodactylus naujanensis** Taylor, 1919, Philippine Jour. Sci., 14: 113.

HOLOTYPE: 2050: Philippines, Mindoro, Naujan Lake; E. H. Taylor; 25 Apr. 1916.

PARATYPES: 2051, 2645 (9 specimens): same data as holotype.

**Lygodactylus capensis mossambica** Loveridge, 1920, Proc. Zool. Soc.

London: 135, -type in BMNH. *Lygodactylus grotei grotei* Sternfeld, according to Loveridge, 1957, Bull. Mus. Comp. Zool., 117: 187.

PARATYPE: 4346: Mozambique, Lumbo; A. Loveridge; 11 July 1918.

**Lygodactylus laurae** Schmidt, 1933, Ann. Carnegie Mus., 22: 4.

*Lygodactylus angolensis* Bocage, according to Loveridge, 1957, Bull. Mus. Comp. Zool., 117: 187.

HOLOTYPE: 5860: Angola, Bihe, Chitau; R. and L. Boulton; 12 Jan. 1931.

PARATYPE: 5934: Angola, Bihe, Gauca; R. and L. Boulton; 8 Jan. 1931.

**Lygosoma auriculatum auriculatum** (Taylor); see **Siaphos auriculatum** Taylor.

**Lygosoma auriculatum kempi** (Taylor); see **Siaphos kempi** Taylor.

**Lygosoma pulchellum taylori** Brown and Alcalá; see **Leirolepisma pulchellum grande** Taylor.

**Mabuya guaporicola** Dunn, 1935, Proc. Acad. Nat. Sci. Philadelphia, 87: 549.

HOLOTYPE: 962: Brazil, Mato Grosso, headwaters of the Rio Guapore, near Bastos Farm on the Rio Alegre; J. D. Haseman; 29 June 1909.

**Morunasaurus groi** Dunn, 1933, Occas. Papers Boston Soc. Nat. Hist., 8: 76, -type in MCZ.

PARATYPE: 6637: Panama, Panama, El Valle de Anton; E. R. Dunn; 5-12 Aug. 1932.

**Pachydactylus bibroni pulitzeræ** Schmidt, 1933, Ann. Carnegie Mus., 22: 6.

HOLOTYPE: 5619: Angola, Mossamedes, Pico Azevedo; R. and L. Boulton; 9 Oct. 1930.

**Pantodactylus schreibersii albostrigatus** (Griffin); see **Prionodactylus albostrigatus** Griffin.

**Prionodactylus albostrigatus** Griffin, 1917, Ann. Carnegie Mus., 11: 314.  
*Pantodactylus schreibersii albostrigatus* (Griffin), according to Ruidabal, 1952, Bull. Mus. Comp. Zool., 106: 517.

HOLOTYPE: 952: Brazil, Minas Geraes, Sete Lagoas; J. D. Haseman; 5 May 1908.

**Prionodactylus eigenmanni** Griffin, 1917, Ann. Carnegie Mus., 11: 316.  
*Euspondylus bolivianus* Werner, according to Burt and Burt, 1931, Bull. Amer. Mus. Nat. Hist., 61: 334.

HOLOTYPE: 981: Bolivia, Santa Cruz, Province del Sara, 400 m.; J. Steinbach; Sept., 1911.

**Rhoptropus boultoni** Schmidt, 1933, Ann. Carnegie Mus., 22: 7.  
*Rhoptropus boultoni boultoni* Schmidt.

HOLOTYPE: 5634: Angola, Mossamedes, Pico Azevedo; R. and L. Boulton; 9 Oct. 1930.

PARATYPES: 5624-25, 5627, 5630, 5635-37, 5639-41, 5643-44: same data as holotype.

**Sceloporus undulatus erythrocheilus** Maslin, 1956, Herpetologica, 12: 291, -type in USNM.

PARATYPE: 40002: Colorado, Las Animas Co., 12 mi. E Model, Purgatoire River; T. P. Maslin and H. A. Fehlmann; 17 Sept. 1949 (UCM 5047).

**Scincus richmondi** Haas, 1961, Ann. Carnegie Mus., 36: 24.

HOLOTYPE: 33515: Saudi Arabia, Al Hasa, southeastern Jafura Desert; R. S. Mathews; Apr., 1954.

PARATYPES: 33513-14, 33517: same data as holotype.

**Siaphos auriculatum** Taylor, 1917, Philippine Jour. Sci., (D) 12: 377.

*Lygosoma auriculatum auriculatum* (Taylor), according to Brown and Alcalá, 1956, Occas. Papers Nat. Hist. Mus. Stanford, 3: 5.

HOLOTYPE: 1737: Philippines, Negros, Canlaon Volcano, 900 m.; E. H. Taylor; 23 Dec. 1916.

PARATYPES: 1738-39: same data as holotype.

**Siaphos kempfi** Taylor, 1919, Philippine Jour. Sci., 14: 118. *Lygosoma auriculatum kempfi* (Taylor), according to Brown and Alcalá, 1956, Occas. Papers Nat. Hist. Mus. Stanford, 3: 5.

HOLOTYPE: 1734: Philippines, Mindoro, Naujan Lake; E. H. Taylor; 23 Apr. 1916.

PARATYPES: 1735-36: same data as holotype.

**Sphaerodactylus copei cataplexis** Schwartz and Thomas, 1964, Quart. Jour. Florida Acad. Sci., 27: 326, -type in MCZ.

PARATYPES: 39445-64: Haiti, Dept. Du Sud, Camp Perrin, native collectors; 24 July 1962.

**Sphenomorphus arborens** Taylor, 1917, Philippine Jour. Sci., (D) 12: 373.

HOLOTYPE: 1891: Philippines, Negros, Canlaon Volcano; E. H. Taylor; 20 Dec. 1915.

PARATYPES: 1892-93, 1895, 1898, 1900-04: same data as holotype.

**Sphenomorphus coxi** Taylor, 1915, Philippine Jour. Sci., (D) 10: 100, -type in BSP.

PARATYPE: 1740: Philippines, Mindanao, Bunawan; E. H. Taylor; June, 1912.

**Sphenomorphus curtirostris** Taylor, 1915, Philippine Jour. Sci., (D) 10: 101, -type in BSP.

PARATYPES: 2251-52: Philippines, Mindanao, Bunawan; E. H. Taylor; 8 Sept. 1912. 2255-56: Philippines, Mindanao, Mainit Lake; E. H. Taylor; 1913.

**Sphenomorphus jagorii divergens** Taylor, 1922, Philippine Bur. Sci., publ. 17: 194, -type not designated.

SYNTYPES: 1759, 1761-66: Philippines, Mindoro, Sumagui and Pocanil; E. H. Taylor; May, 1916. 1767-69, 1771-72, 1774, 1776, 1778: Philippines, Mindoro, Calapan and San Isidro; E. H. Taylor; Nov., 1916.

**Sphenomorphus jagorii grandis** Taylor, 1922, Philippine Bur. Sci., publ. 17: 195.

HOLOTYPE: 1722: Philippines, Negros, Canlaon Volcano; E. H. Taylor; 25 Dec. 1915.

PARATYPE: 1723: same data as holotype.

**Sphenomorphus lednickyi** Taylor, 1919, Philippine Jour. Sci., 14: 120.

HOLOTYPE: 2643: Philippines, Masbate, near Aroroy gold mines; V. E. Lednický; June, 1917.

PARATYPE: 2544: same data as holotype.

**Sphenomorphus mindanensis** Taylor, 1915, Philippine Jour. Sci., (D) 10: 99, -type in BSP.

PARATYPE: 1733: Philippines, Mindanao, Bunawan; E. H. Taylor; Sept., 1912.

**Tropidophorus rivularis** Taylor, 1915, Philippine Jour. Sci., (D) 10: 106, -type in BSP.

PARATYPES: 2403, 2405-07: Philippines, Mindanao, Bunawan; E. H. Taylor; July, 1912.

*Varanus albigularis angolensis* Schmidt, 1933, Ann. Carnegie Mus., 22: 10. *Varanus exanthematicus angolensis* Schmidt, according to Mertens, 1937, Abhandl. Senckenbergische Naturf. Gesell., 435: 9.  
HOLOTYPE: 5697: Angola, Bihe, Gauca; R. and L. Boulton; 10 Jan. 1931.

*Varanus exanthematicus angolensis* Schmidt; see *Varanus albigularis angolensis* Schmidt.

### Suborder SERPENTES

*Ahaetulla prasina preocularis* (Taylor); see *Dryophis preocularis* Taylor.

*Aporophis melanocephalus* Griffin, 1915, Mem. Carnegie Mus., 7: 171. *Rhadinaea steinbachi* Boulenger, according to Dunn, 1922, Proc. Biol. Soc. Washington, 35: 220.  
HOLOTYPE: 18: Bolivia, Santa Cruz, Las Yuntas, 250 m.; J. Steinbach; Dec., 1913.

*Atractus sanctaemartae* Dunn, 1946, Occas. Papers Mus. Zool. Univ. Michigan, 493: 2, -type in UMMZ.  
PARATYPES: 201: Colombia, Minca, 2000 ft.; H. H. Smith; July, 1901. 215: Colombia, El Libano, 6000 ft.; H. H. Smith; May, 1901.

*Atractus taeniatus* Griffin, 1915, Mem. Carnegie Mus., 7: 173.  
HOLOTYPE: 117: Bolivia, Santa Cruz; J. Steinbach; date unknown.

*Boiga dendrophila divergens* Taylor, 1922, Philippine Bur. Sci., publ. 16: 201.  
HOLOTYPE: 2143: Philippines, Luzon, Mt. Maquiling; E. H. Taylor; 12 Nov. 1913.

*Bothrops insularis* (Amaral); see *Lachesis insularis* Amaral.

*Bothrops neuwiedii bolivianus* Amaral, 1927, Bull. Antivenin Inst. America, 1: 6.  
HOLOTYPE: 2728: Bolivia, Santa Cruz, Buenavista; J. Steinbach; 1918.  
PARATYPES: 1, 4, 34-35, 38, 40, 46, 49, 54-55, 58, 60-61, 67-69, 119-20, 122-23, 2710-15, 2723-27, 2729-31, 2771, 2773, 2801-02, 2814-15, 2819, 2829, 2856-59, 2877, 2896, 2902-04, 2913, 2923-26, 2928, 2933-34, 2959-60, 2963-65: same locality and collector as holotype; various dates.

**Calamaria gervaisii iridescens** Taylor, 1917, Philippine Jour. Sci., (D) 12: 360.

HOLOTYPE: 8806: Philippines, Negros, Canlaon Volcano; E. H. Taylor; 23 Dec. 1915.

PARATYPES: 2626, 2633, 8807, 8809: same data as holotype.

**Clelia euprepa** Griffin, 1915, Mem. Carnegie Mus., 7: 203.

*Siphlophis cervinus* (Laurenti), according to Amaral, 1926, Ann. Carnegie Mus., 16: 323.

HOLOTYPE: 109: Bolivia, Santa Cruz, Santa Cruz; J. Steinbach; date unknown.

PARATYPE: 108: same data as holotype.

**Clelia peruviana** Griffin, 1915, Mem. Carnegie Mus., 7: 204. *Oxyrhopus petola* (L.), according to Amaral, 1926, Ann. Carnegie Mus., 16: 323.

HOLOTYPE: 377: Peru, Loreto, Tarma; L. Vance; date unknown.

**Coluber constrictor paludicola** Auffenberg and Babbitt, 1953, Copeia: 44, -type in USNM.

PARATYPE: 29736: Florida, Dade Co., Perrine; W. Auffenberg; 15 Mar. 1950.

**Crotalus confluentus abyssus** Klauber, 1930, Trans. San Diego Soc. Nat. Hist., 6: 114, -type in LMK. *Crotalus viridis abyssus* Klauber, according to Klauber, 1936, Trans. San Diego Soc. Nat. Hist., 8: 242.

PARATYPE: 20294: Arizona, Coconino Co., north rim Grand Canyon, Roaring Springs Power Plant on Bright Angel Creek; S. B. Jones; 9 Oct. 1929 (LMK 2215).

**Crotalus durissus vegrandis** Klauber; see *Crotalus vegrandis* Klauber.

**Crotalus vegrandis** Klauber, 1941, Trans. San Diego Soc. Nat. Hist., 9: 334. *Crotalus durissus vegrandis* Klauber, according to Klauber, 1956, "Rattlesnakes," p. 34.

HOLOTYPE: 17384: Venezuela, Monagas, Maturin Savannah near Uracoa; H. A. Beatty; 1939.

**Crotalus viridis abyssus** Klauber; see *Crotalus confluentus abyssus* Klauber.

**Dromicus andreae nebulatus** (Barbour); see *Leimadophis nebulatus* Barbour.



**Dryophis preocularis** Taylor, 1922, Philippine Bur. Sci., publ. 16: 222.  
*Ahaetulla prasina preocularis* (Taylor), according to Stejneger, 1933, Copeia: 199-203.

HOLOTYPE: 2617: Philippines, Mindanao, Bunawan; E. H. Taylor; 12 Mar. 1913.

**Eirenis arabica** Haas, 1961, Ann. Carnegie Mus., 36: 20.

HOLOTYPE: 33511: Saudi Arabia, Al Hasa, Abqaiq; R. S. Mathews; Mar., 1951.

**Elaps colombianus** Griffin, 1915, Mem. Carnegie Mus., 7: 216. *Micrurus dumerilii* (Jan), according to Amaral, 1926, Ann. Carnegie Mus., 16: 323.

HOLOTYPE: 197: Colombia, Minca; H. H. Smith; June, (1901?).

PARATYPES: 2031, 2033: Colombia, Cacagualito; Mrs. H. H. Smith; 1898 to 1901.

**Elaps hollandi** Griffin, 1915, Mem. Carnegie Mus., 7: 218. *Micrurus dissolucus melanogenys* (Cope), according to Schmidt, 1936, Field Mus. Nat. Hist., zool. ser., 20: 203.

HOLOTYPE: 206: Colombia, Bonda; H. H. Smith; June, 1901.

PARATYPE: 207: same data as holotype.

**Epicrates exsul** Netting and Goin, 1944, Ann. Carnegie Mus., 30: 71.

HOLOTYPE: 21048: Bahamas, Great Abaco, near Blackrock; A. C. Twomey; 6 Feb. 1942.

**Epicrates striatus fosteri** Barbour, 1941, Proc. New England Zool. Club, 18: 64, -type in MCZ.

PARATYPE: 21962: Bahamas, North Bimini, near Alicetown; R. W. Foster and J. H. Huntington; June, 1941.

**Haldea valeriae pulchra** Richmond, 1954, Ann. Carnegie Mus., 33: 251.

HOLOTYPE: 32205: Pennsylvania, Venango Co., Ten Mile Bottom, 4 mi. N Van; N. D. Richmond; 10 Aug. 1953.

PARATYPES: 29382, 29384: Pennsylvania, Venango Co., 1 mi. NE Sadler's Corners; Shively, Borland, and Swanson; 29 June 1949. 32137, 32140-46: Pennsylvania, Warren Co., 10 mi. SW Warren along US 62; N. D. Richmond; 27 May 1953. 32204: same data as holotype. 32219: Pennsylvania, Forest Co., 3 mi. SW Tionesta, west side of Allegheny River; N. D. Richmond; 10 Aug. 1953.

**Helminthophis bondensis** Griffin, 1915, Mem. Carnegie Mus., 7: 165. *Liotyphlops albirostris* (Peters), according to Dunn, 1944, Caldasia, 3: 50.

HOLOTYPE: 216: Colombia, Bonda; H.H. Smith; May (year unknown).

**Holarchus burksi** Taylor, 1918, Philippine Jour. Sci., (D) 13: 365.  
*Oligodon ancorus* (Girard), according to Leviton, 1962, Philippine Jour. Sci., 91: 464.

HOLOTYPE: 2575: Philippines, Mindoro, Sumagui; C. Burks; Dec., 1916.

**Holarchus maculatus** Taylor, 1918, Philippine Jour. Sci., (D) 13: 364.  
*Oligodon maculatus* (Taylor), according to Leviton, 1962, Philippine Jour. Sci., 91: 469.

HOLOTYPE: 2571: Philippines, Mindanao, Bunawan; E. H. Taylor; Aug., 1912.

PARATYPE: 2572: same data as holotype.

**Lachesis insularis** Amaral, 1921, Anexos Mem. Inst. Butantan (Ofiologia), 1: 18, -type in IB. *Bothrops insularis* (Amaral), according to Amaral, 1930, Mem. Inst. Butantan, 4: 235.

PARATYPE: 2682: Brazil, Sao Paulo, Queimada Grande Island; A. do Amaral; Dec., 1920.

**Leimadophis nebulatus** Barbour, 1916, Ann. Carnegie Mus., 10: 305, -type in MCZ. *Dromicus andreae nebulatus* (Barbour), according to Schwartz and Thomas, 1960, Herpetologica, 16: 81.

PARATYPES: 303-07: Cuba, Habana Province, Isle of Pines, Los Indios; G. A. Link; May, 1912-June, 1913. 1535: same locality and collector; May, 1910.

**Leimadophis zweifeli** Roze, 1959, Amer. Mus. Novitates, 1934: 4, -type in MBUCV.

PARATYPES: 7355: Venezuela, Distrito Federal, El Limon; E. G. Holt; 19 Jan. 1929. 22780: Venezuela, Miranda, Naiguata, Los Canales; E. Mondolfi and G. Vivas; 23 July 1939. [Number 22780 was incorrectly cited in the description as number 2278.]

**Leptophis ahaetulla bolivianus** Oliver, 1942, Occas. Papers Mus. Zool. Univ. Michigan, 462: 1, -type in UMMZ.

PARATYPES: 23: Bolivia, Santa Cruz, Las Yuntas; J. Steinbach; Nov.-Dec., 1913. 2702: Bolivia, Santa Cruz, Buena Vista; J. Steinbach; 1917-1919.

**Leptophis ahaetulla coeruleodorsus** Oliver; see **Leptophis coeruleodorsus** Oliver.

**Leptophis coeruleodorsus** Oliver, 1942, Occas. Papers Mus. Zool. Univ. Michigan, 462: 4, -type in AMNH. *Leptophis ahaetulla coeruleodorsus* Oliver, according to Oliver, 1948, Bull. Amer. Mus. Nat. Hist., 92: 228.

PARATYPES: 6491: Trinidad, St. George Co., Mt. St. Benedict; M. G. Netting; 9 Sept. 1927. [Number 6491 was incorrectly cited in the description as number 6490.] 6540: same locality and collector; 17 Sept. 1927. 7433: Venezuela, Miranda, 11 km. ENE Santa Lucia on the Quebrada Siquire; E. G. Holt; 15 Aug. 1929.

**Leptotyphlops columbi** Klauber, 1939, Trans. San Diego Soc. Nat. Hist., 9: 62.

HOLOTYPE: 1364: Bahamas, San Salvador (Watlings Island); W. W. Worthington; 1909.

PARATYPES: 1360, 1362: same data as holotype.

**Leptotyphlops emini pembae** Loveridge, 1941, Proc. Biol. Soc. Washington, 54: 177, -type in MCZ.

PARATYPE: 23932: Tanzania, Pemba Island, Vitongoje; R. H. W. Pakenham; 4 Oct. 1940 (MCZ 46121).

**Leptotyphlops muñaoui** Orejas-Miranda, 1961, Acta Biol. Venezuelica, 3: 85, -type in MBUCV.

PARATYPE: 38970: Uruguay, Tacuarembó, Tambores, Pozo Hondo; M. A. Klapenbach and P. R. San Martín; Sept., 1956.

**Leptotyphlops tenella** Klauber, 1939, Trans. San Diego Soc. Nat. Hist., 9: 59, -type in AMNH.

PARATYPES: 4888: Trinidad, St. George Co., Mt. St. Benedict; M. G. Netting; 8 Sept. 1927. 4889: same locality and collector; 10 Sept. 1927. 4892: same locality and collector; 16 Sept. 1927. 4893: Trinidad, St. George Co., El Dorado; M. G. Netting; 19 Sept. 1927.

**Liophis elaeoides** Griffin, 1915, Mem. Carnegie Mus., 7: 187. *Leimadophis typhlus* (L.), according to Amaral, 1926, Ann. Carnegie Mus., 16: 322.

HOLOTYPE: 32: Bolivia, Santa Cruz, Santa Cruz; J. Steinbach; Feb., 1913.

PARATYPES: 44: same locality and collector as holotype; 15-26 Dec. 1912. 59: same locality and collector; Jan-Oct., 1911. 91-92, 94-95, 98-100: same locality and collector; date unknown.

**Macropophis dendrophiops negrosensis** (Taylor); see *Natrix dendrophiops negrosensis* Taylor.

**Naja naja philippinensis** Taylor, 1922, Philippine Bur. Sci., publ. 16: 265, -type in BSP.

PARATYPE: 2570: Philippines, Luzon, Pampanga; Guerrero; 10 Aug. 1918.

**Natrix dendrophiops negrosensis** Taylor, 1917, Philippine Jour. Sci., (D) 12: 356. *Macropophis dendrophiops negrosensis* (Taylor), according to Malnate, 1960, Proc. Acad. Nat. Sci. Philadelphia, 112: 48. HOLOTYPE: 2261: Philippines, Negros, Canlaon Volcano; E. H. Taylor; Dec., 1915.

PARATYPES: 2262-63: same data as holotype.

**Natrix erythrogaster flavigaster** Conant, 1949, Copeia: 2, -type in CNHM.

PARATYPE: 27834: Louisiana, St. James Parish, Gramercy; G. P. Meade; 20 June 1947.

**Natrix harteri paucimaculata** Tinkle and Conant, 1961, Southwestern Nat., 6: 34, -type in AMNH.

PARATYPES: 37533-34: Texas, Coke Co., Colorado River south of Robert Lee; D. W. Tinkle and D. L. McGregor; 8 Oct. 1960.

**Natrix rhombifera blanchardi** Clay, 1938, Ann. Carnegie Mus., 27: 251.

HOLOTYPE: 9512: Mexico, Veracruz and Tamaulipas, up to 85 miles from Tampico, between Rio Tamesi and Rio Panuco; J. M. Sheppard; 15 Jan.-20 Feb. 1937.

PARATYPES: 9513, 9515: same data as holotype.

**Natrix rigida sinicola** Huheey, 1959, Copeia: 305, -type in UIMNH.

PARATYPES: 9894: Alabama, Lee Co., 2 mi. SW Auburn; G. C. Moore; 15 May 1937. 24012: Arkansas, Saline Co., Benton; R. H. McCauley, Jr.; 20 July 1944.

**Natrix valida isabelleae** Conant, 1953, Chicago Acad. Sci., Nat. Hist. Misc., 126: 7, -type in AMNH.

PARATYPES: 29650-55, 29657: Mexico, Guerrero, Laguna Coyuca, at Pie de la Cuesta; M. Silverman; Dec., 1950 and Jan., 1951.

**Ninia sebae morleyi** Schmidt and Andrews, 1936, Field Mus. Nat. Hist., zool. ser., 20: 169, -type in CNHM.

PARATYPE: 23933: Mexico, Yucatan, Chichen Itza; W. H. Thompson; date unknown (MCZ 26825).

**Oligodon maculatus** (Taylor); see *Holarchus maculatus* Taylor.

**Phyllorhynchus decurtatus perkinsi** Klauber, 1935, Bull. Zool. Soc. San Diego, 12: 11, -type in LMK.

PARATYPE: 18524: California, San Diego Co., Dry Lake; P. Benson; 10 June 1935 (LMK 23921).

**Pseudorabdion macnamarae** Taylor; see **Pseudorhabdium macnamarae** Taylor.

**Pseudorhabdium macnamarae** Taylor, 1917, Philippine Jour. Sci., (D) 12: 363. *Pseudorabdion macnamarae* Taylor, according to Leviton and Brown, 1959, Proc. California Acad. Sci., 29: 498, who point out that *Pseudorhabdium* is an erroneous subsequent spelling first used in Boulenger, 1894, "Catalogue of snakes," 2: 328.

HOLOTYPE: 2606: Philippines, Negros, Canlaon Volcano; E. H. Taylor; 24 Dec. 1915.

PARATYPES: 2607-09, 2611-14, 2616: same data as holotype.

**Rhadinaea orina** Griffin, 1915, Mem. Carnegie Mus., 7: 195. *Liophis miliaris* (L.), according to Amaral, 1926, Ann. Carnegie Mus., 16: 322.

HOLOTYPE: 264: "the Sierras of Bolivia"; LeBoutelier Collection; no additional data.

PARATYPES: 263, 265-67: same data as holotype.

**Storeria dekayi texana** Trapido, 1944, Amer. Midland Nat., 31: 63.

HOLOTYPE: 21656: Texas, Kendall Co., Edge Falls, 4 mi. S Kendalia; A. J. Kirn; 16 June 1942 (CU 3530).

**Tretanorhinus insulae-pinorum** Barbour, 1916, Ann. Carnegie Mus., 10: 306. *Tretanorhinus variabilis insulaepinorum* Barbour, according to Wood, 1939, Proc. New England Zool. Club, 18: 6.

HOLOTYPE: 311: Cuba, Habana Province, Isle of Pines, Los Indios; G. A. Link; 1912-1913.

PARATYPE: 310: same data as holotype.

**Tretanorhinus variabilis insulaepinorum** Barbour; see **Tretanorhinus insulae-pinorum** Barbour.

**Trimeresurus wagleri albobiridis** Taylor, 1917, Philippine Jour. Sci., (D) 12: 366. *Trimeresurus wagleri* (Boie), according to Leviton, 1964, Philippine Jour. Sci., 93: 267.

HOLOTYPE: 2433: Philippines, Negros, Isabela; E. H. Taylor; 12 Sept. 1915.

**Tropidodipsas spilogaster** Griffin, 1915, Mem. Carnegie Mus., 7: 197. *Sibynomorphus turgidus* (Cope), according to Amaral, 1926, Ann. Carnegie Mus., 16: 322.

HOLOTYPE: 42: Bolivia, Santa Cruz, Province del Sara; J. Steinbach; Nov., 1912.

PARATYPE: 47: same locality and collector; 15-26 Dec. 1912.



**Tropidophis melanurus ericksoni** Schwartz and Thomas, 1960, *Herpetologica*, 16: 74, -type in AMNH.

PARATYPES: 283: Cuba, Habana Province, Isle of Pines; G. A. Link; 1912-1913.  
1521: same locality and collector; May, 1910.

**Typhlops biminiensis** Richmond, 1955, *Amer. Mus. Novitates*, 1734: 2.

HOLOTYPE: 32604: Bahamas, South Bimini, near Nixon's Harbour; M. G. Netting and N. D. Richmond; 27 Mar. 1954.

**Typhlops canlaonensis** Taylor, 1917, *Philippine Jour. Sci.*, (D) 12: 354.

HOLOTYPE: 2666: Philippines, Negros, Canlaon Volcano, 750 m.; E. H. Taylor; 25 Dec. 1915.

**Typhlops dendrophis** Taylor, 1922, *Philippine Bur. Sci.*, publ. 16: 60.

HOLOTYPE: 2668: Philippines, Mindanao, Bunawan; E. H. Taylor; 15 Aug. 1913.

PARATYPES: 2669-70: same data as holotype.

**Typhlops haitiensis** Richmond, 1964, *Breviora*, 202: 5, -type in MCZ.

PARATYPES: 38804-08: Haiti, Manneville; G. Whiteman; Apr., 1963.

**Typhlops longicauda** Taylor, 1919, *Philippine Jour. Sci.*, 14: 108.

HOLOTYPE: 2671: Philippines, Mindanao, Bunawan; E. H. Taylor; 15 July 1913.

PARATYPES: 2672, 2674-75, 2677, 2679, 2681: same locality and collector; 1912-1913.

**Typhlops luzonensis** Taylor, 1919, *Philippine Jour. Sci.*, 14: 105.

HOLOTYPE: 2653: Philippines, Luzon, Mount Maquiling, Laguna; E. H. Taylor; 12 May 1915.

**Typhlops mindanensis** Taylor, 1922, *Philippine Bur. Sci.*, publ. 16: 65.

HOLOTYPE: 2667: Philippines, Mindanao, Bunawan; E. H. Taylor; 12 Aug. 1913.

**Typhlops rugosa** Taylor, 1919, *Philippine Jour. Sci.*, 14: 109.

HOLOTYPE: 2665: Philippines, Mindanao, Bunawan; E. H. Taylor; 14 July 1913.

**Urotheca williamsi** Roze, 1958, *Breviora*, 88: 1, -type in MCZ.

PARATYPE: 7393: Venezuela, Aragua, Colonia Tovar, 1800 m.; E. G. Holt; 30 Apr. 1929.

ADDITIONAL TREEFROGS (HYLIDAE) FROM THE NORTH  
AMERICAN PLEISTOCENEJOHN D. LYNCH<sup>1</sup>Department of Zoology and Museum of Natural History  
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Fossil treefrogs are comparatively rare. Published records are available from California, Florida, Kansas, Nebraska, Oklahoma, and Texas. These deposits range from Lower Miocene (Thomas Farm, Gilchrist County, Florida) to late Pleistocene deposits in Florida, Oklahoma and Texas. Except for the mention of "*Hyla* cf. *crucifer*" (Richmond in Guilday, *et al.*, 1964) and of "*Hyla* sp" (McCrady and Schmidt, 1963) no fossil treefrogs have been reported from the eastern United States outside of Florida.

Pleistocene treefrogs recently have been recovered from deposits in Maryland, Pennsylvania, and Tennessee. These specimens are part of the collections of the Section of Vertebrate Fossils, Carnegie Museum (CM). It is also possible to report the identifications of several treefrog fossils from the Wisconsin deposits of Hardeman County, Texas. Holman (1964) listed these fossils as "Hylidae indet."

Specimens identified by the abbreviation MU are from Midwestern University, Wichita Falls, Texas.

A characteristic useful in generic and specific identifications of hylid ilia has been pointed out by Holman (1962: 256) and Chantell (1964: 215). The position of the anterior edge of the dorsal protuberance relative to the anterior edge of the acetabular fossal border is divided into three categories by these authors: posterior to, even with, or anterior to. Holman's groups are less clearly defined than those of Chantell's and I follow Chantell's terminology.

In attempting to identify two hylid ilia from Hardeman County, Texas, I examined 414 ilia (Recent) of seven genera for protuberance position relative to the fossal border. When adequate series are available, it becomes apparent that there is often considerable variation in this character (Table 1). Most *Hyla* species have the protuberance even with or posterior to the anterior margin of the acetabular fossa but *Hyla crucifer* is a notable exception (Table 1).

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TABLE 1

POSITION OF ANTERIOR BORDER OF DORSAL PROTUBERANCE OF THE ILIUM RELATIVE TO ANTERIOR BORDER OF ACETABULUM IN 34 HYLID SPECIES (414 SPECIMENS)

Species	Posterior $\frac{1}{2}$	Even	Anterior $\frac{1}{2}$
<i>Acris crepitans</i>			108
<i>Acris gryllus</i>			12
<i>Agalychnis callidryas</i>	9	1	
<i>A. moreleti</i>	2		
<i>Diaglena reticulata</i>		2	
<i>D. spatulata</i>		2	
<i>Hyla andersoni</i>	2	4	
<i>H. arborea</i>	1	12	
<i>H. arborescens</i>	1	14	1
<i>H. arenicolor</i>		1	
<i>H. avivoca</i>		8	
<i>H. cinerea</i>	4	20	2
<i>H. crepitans</i>	1	1	
<i>H. crucifer</i>		1	53
<i>H. euphorbiacea</i>	1	2	2
<i>H. gratiosa</i>		4	
<i>H. microcephala</i>	8	5	
<i>H. picta</i>		3	
<i>H. regilla</i>	1	4	1
<i>H. septentrionalis</i>	9	1	
<i>H. squirella</i>		6	2
<i>H. staufferi</i>		5	3
<i>H. versicolor</i>	1	26	1
<i>H. wrightorum</i>	1	1	
<i>Limnaoedus ocularis</i>		4	3
<i>Pseudacris brachyphona</i>		2	
<i>P. brimleyi</i>		2	
<i>P. clarki</i>			2
<i>P. nigrita</i>		2	2
<i>P. ornata</i>			2
<i>P. streckeri</i>		2	10
<i>P. triseriata</i>		19	11
<i>Pternohyla dentata</i>			2
<i>P. fodiens</i>		2	

*Hyla crucifer* (Wied)

MATERIAL: 2 left ilia and 1 right ilium (CM 12533); Sinkhole No. 4, New Paris, Bedford County, Pennsylvania; 11,300 B.P.  $\pm$  1000 years, carbon dating (Guilday, *et al.*, 1964).

2 right ilia (CM 12576-12577), Cumberland Cave, east face, Alleghany County, Maryland; "pre-Wisconsin," Pleistocene.

The New Paris specimens are large, representing individuals 33 to 40 mm. in snout-vent length, thus exceeding the largest known Recent specimens (1¾ inches, Conant, 1958: 278). The two specimens from Cumberland Cave are smaller, about 30 mm. in snout-vent length. These fossils represent the first definite report of *Hyla crucifer* from the Pleistocene. Guilday *et al.* (1964) tentatively referred the New Paris specimens to this species.

It appears that the Pleistocene specimens of several species of frogs attained greater size than do modern specimens of the same species. Chantell (1964: 221) has reported larger *Acris* and *Pseudacris* and Mecham (1959) has recorded very large *Bufo woodhousei*. J. Alan Holman has permitted me to examine his specimens of *Rana catesbeiana*, from the Florida Pleistocene, which exceed 200 mm. in snout-vent length. The striking feature is not so much that these frogs were large but that the entire population of bullfrogs apparently was composed of giant (by present standards) specimens.

*Hyla femoralis* Sonnini and Latreille

MATERIAL: 1 right ilium (CM 12579), Robinson Cave, Overton County, Tennessee; Pleistocene, stage not determined.

The low ilial prominence makes fossil ilia of this species relatively easy to identify. The dorsal protuberance is directed laterally, oval, prominent, and relatively close to the acetabular fossa border. The angle of ventral expansion is large and the dorsal acetabular expansion is not directed so much dorsally as posteriorly, accentuating the flat appearance of the bone.

At present, this species occurs only in the southeastern United States. Its range does not extend north into the Mississippi Valley as it may have during one or more of the Pleistocene interglacial periods. The species has previously been recorded as a fossil from the Pleistocene of Florida (Holman, 1959, and Lynch, 1965), and a dubious record is available from the Mio-Pliocene of Nebraska (Chantell, 1964). The age of the deposits from Robinson Cave is not definitely known. According to Richmond (personal communication) the fossil was found in a

deposit that included armadillo, sloth, and caribou. Such an association (containing northern as well as southern indicators) suggests extensive mixing has occurred. Judging from the present distribution of *Hyla femoralis*, it would be reasonable to say that the fossil was deposited during an interglacial period when the range of *Hyla femoralis* extended up the Mississippi Valley.

*Hyla holmani*, new species

Two of the fossils reported by Holman as "Hylidae indeterminate" have the fossa-protuberance relationship intermediate between the "even with" and "anterior  $\frac{1}{2}$ " groups of Chantell (1964). On the basis of the proximity of the protuberance to the fossa and the shape of the ventral acetabular expansion these specimens are referred to the genus *Hyla*.

Comparison of the fossils with the species of *Hyla* in eastern Texas (*chrysoscelis*, *cinerea*, *crucifer*, *squirella*, and *versicolor*) as well as with those of the rest of the United States and northern Mexico, indicates that the fossils represent an undescribed (and presumably extinct) species:

HOLOTYPE: MU 6581, distal 5.1 mm. of a left ilium (Fig. 1), Walter W. Dalquest, collector.

REFERRED SPECIMEN (1): MU 6582, fragmentary right ilium.

TYPE LOCALITY: Groesbeck Creek Fauna, 5 miles north, 1 to 2 miles west of Quanah, Hardeman County, Texas.

HORIZON: Wisconsin glacial, Pleistocene.

DIAGNOSIS AND DEFINITION: A *Hyla* of uncertain affinities whose ilia can be distinguished from those of other North American species by the following: acetabular fossa shallow; dorsal protuberance ovoid, its anterior edge slightly anteriad or even with anterior border of acetabular fossa; protuberance separated from dorsal border of fossa by distance about equal to three-quarters the depth of the protuberance; ventral acetabular expansion reduced, extending well along the ilial shaft as a narrow expansion (Fig. 1); no ilial shaft ridge.

DESCRIPTION OF HOLOTYPE: Fig. 1A, distal 5.1 mm. of a left ilium; most of ventral acetabular expansion broken; anteriorly the expansion is a narrow ridge-like structure along the ventral edge of the ilial shaft; acetabular fossa large, shallow, rounded; dorsal acetabular expansion lost through breakage; ilial prominence massive, ovoid, with roughened surface, its anterior edge just in front of the anterior edge of the acetabular border; shaft without ridges or crests.



The referred specimen (Fig. 1B) is slightly smaller and less complete and has a much better defined dorsal protuberance. It is referred to *Hyla holmani* on the basis of the shape of the ventral acetabular expansion.

COMPARISONS: All other North American *Hyla* and *Pseudacris* examined have a broader ventral acetabular expansion with the possible exception of a Mio-Pliocene fossil form (*Hyla* sp., Valentine formation, Nebraska, Chantell, 1964). This fossil is fragmentary and the detail of the illustration is not clear, but it may be related to *Hyla holmani*.

The dorsal protuberance and ilial prominence of the *versicolor* group (see Lynch, 1965, for definitions of the species groups) are wholly dissimilar to the fossil *holmani* in being triangular or subtriangular. In the *goiini* group, the protuberance is situated much closer to the dorsal border of the acetabular fossa, and in the *crucifer* group, the prominence is more anteriad and there is an ilial shaft ridge (Lynch, 1962, 1965). The dorsal protuberance most closely resembles that of the *cinerea* group, of which *holmani* may be an extinct member, but a definite statement as to the relationships of *holmani* must await collection of more specimens.

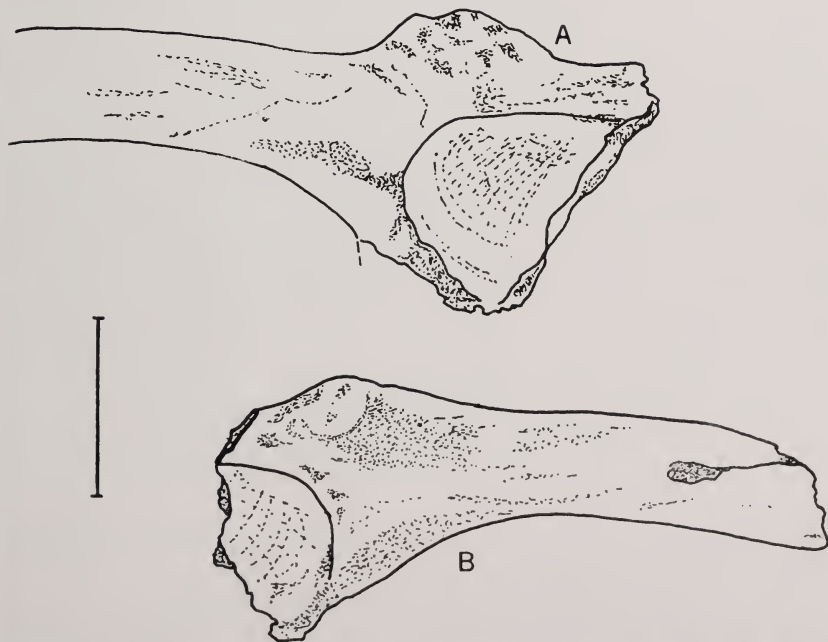


Figure 1. A. Holotype left ilium of *Hyla holmani*, new species, MU 6581. B. Referred specimen of same, MU 6582. Line represents 1 mm.

*Acris crepitans* Baird

MATERIAL: 5 ilia (3 right, 2 left), MU 3260, Groesbeck Creek, Hardeman County, Texas; Wisconsin glacial, Pleistocene.

Holman (1964:76) reported these fossils as "Hylidae indeterminate." However, they are very fragmentary remains of *Acris* as evidenced by the shape of the ventral acetabular expansion and the position of the dorsal protuberance. The fossils appear to represent individuals 25 to 30 mm. in snout-vent length. Holman had recorded the species from this site.

*Pseudacris streckeri* Wright and Wright

MATERIAL: 1 left ilium (distal 4 mm.), MU 3259, Groesbeck Creek, Hardeman County, Texas; Wisconsin glacial, Pleistocene.

Holman (1964) included this specimen in his "Hylidae indeterminate." *Pseudacris streckeri* can be recognized by the ball-like dorsal protuberance of the ilial prominence. The fossil represents an individual about 30 mm. in snout-vent length. The species has not previously been reported as a fossil, and comes from a locality 50 to 75 miles west of the western limit of the present range of the frog in northern Texas.

*Pseudacris triseriata* (Wied)

MATERIAL: 1 left ilium, CM 12578, Cumberland Cave, east face, Allegany County, Maryland; "pre-Wisconsin," Pleistocene.

*Pseudacris triseriata feriarum* is abundant in the area today but has not previously been recorded as a fossil. Two other species of *Pseudacris* (*P. brachyphona* and *P. brimleyi*) may have occurred in the area during some stage of the Pleistocene. Both resemble *P. triseriata* in ilial anatomy but are separable in that the dorsal protuberance of *brimleyi* is shorter than that of *triseriata*, and the more anterior portion of the ventral acetabular expansion is larger in *brachyphona* than in *triseriata*. This fossil most closely resembles *P. triseriata* and is referred to that species. It differs from most specimens of *triseriata* by the unusual rugosity of the dorsal protuberance, but this may reflect individual variation or be due to erosion. However, I have seen *triseriata* with this condition.

These reports bring to 12 the number of treefrogs reported from the North American Pleistocene.

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### SUMMARY

Fossil hylids are recorded from Pleistocene deposits of Maryland, Pennsylvania, Tennessee, and Texas. *Hyla crucifer*, *Pseudacris streckeri*, and *P. triseriata* are reported as fossils for the first time. A new species, *Hyla holmani*, is described from the Wisconsin (Pleistocene) deposits of Hardeman County, Texas. *Acris crepitans* and *Hyla femoralis* are also reported. Two Pleistocene range extensions are noted.

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ADDITIONS TO THE FLOWERING PLANTS  
OF WESTERN PENNSYLVANIA

DOROTHY L. PEARTH

Assistant Curator of Plants

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This article lists 173 species, varieties, forms, or hybrids of flowering plants that are now in the Carnegie Museum Herbarium, and not included or merely listed as reported or possibly occurring in "The Wild Flowers of Western Pennsylvania and the Upper Ohio Basin" by O. E. Jennings and Andrey Avinoff, published in 1953.

Many of these are new additions to the Herbarium, acquired through recent collecting, exchange, or procurement of personal herbaria. A number are variations that have been separated according to some of the newer literature. A few, such as the *Rubus*, are genera in our collection recently studied by specialists. Some are reidentifications. Others are introduced species or escapes from cultivation, which were partially ignored in "The Wild Flowers of Western Pennsylvania and the Upper Ohio Basin" (hereinafter referred to as the "Flora").

In all, 100 species, 44 varieties, 27 forms, and 2 hybrids are listed in 115 genera and 54 families. In addition to the native plants, this treatment includes 44 that have been introduced and become partially or wholly naturalized, and 13 that have escaped from cultivation.

Western Pennsylvania here refers to the western part of the State through Potter, Clinton, Centre, Huntingdon, and Fulton counties.

Collectors' names are abbreviated as follows: FHB, Frederick H. Beer; DB, David Berkheimer; JB, John Bright; WEB, Werner E. Buker; LKH, LeRoy K. Henry; GKJ, Grace Kinzer Jennings; OEJ, Otto Emery Jennings; HNM, Harold N. Moldenke; BHP, Berky Hunter Patterson; JAS, John A. Shafer.

Surnames, referring to persons who have reported specimens, apply to the following individuals: Berkheimer (David), Fernald (Merritt L.), Miller (John), Moldenke (Harold N.), Porter (Thomas C.), and Wiegand (K. M.). If publications were involved, citations are given in the "Flora."



An asterisk before a scientific name indicates that, in the Pennsylvania Herbarium, we have the entity from western Pennsylvania only; no asterisk implies that we have it from eastern Pennsylvania also. Mention is made if a genus is new in our Pennsylvania collection.

Families are arranged in phylogenetic order according to Gray's Manual of Botany (8th ed.). Genera and species are listed alphabetically under the family.

Where a common name in the listing differs from that given in the "Flora," it represents an attempt to further standardize hyphenation and capitalization. I have endeavored to follow the outline given by H. W. Rickett in a 1965 article.

#### ZOSTERACEAE, Pondweed Family

\**Potamogeton praelongus* Wulfen. White-stemmed Pondweed.

ERIE CO.: 3 collections from Presque Isle. JB, July 7, 1925; W. R. Witz, Aug. 6, 1928; Wm. R. Van Dersal, June 29-30, 1930.

Listed in "Flora" as reported from Erie and Warren counties.

\**P. pulcher* Tuckerman. Spotted Pondweed.

CRAWFORD CO.: 3 collections from Pymatuning Swamp, Hartstown. JB, May 30, 1915; OEJ, 1909 and May 29, 1931.

Listed in "Flora" as reported from Crawford Co.

\**P. pusillus* Linnaeus. "Very small" Pondweed.

ERIE CO.: 3 collections. Presque Isle, OEJ, July 26, 1925, and W. R. Witz, July 10, 1928; Erie Bay, near hatchery, OEJ, Aug. 15, 1929.

LAWRENCE CO.: Big Run, about 4 miles east of New Castle. Charles M. Boardman, Sept. 18, 1948.

From West Indies, Azores, and Eurasia.

Typical *pusillus* not listed in "Flora," although varieties are.

*Zannichellia palustris* var. *major* (Boenninghausen) W.D.J. Koch.  
Horned Pondweed.

BEDFORD CO.: In ponds, fish hatchery, 1.5 miles southeast of Alum Bank, LKH and WEB, July 30, 1952.

This species was listed in the "Flora" as collected at Erie Bay by W. R. Witz, but the specimen has been reidentified as *Heteranthera dubia*.

From Europe.

#### JUNCAGINACEAE, Arrow-grass Family

*Scheuchzeria palustris* var. *americana* Fernald.

ERIE CO.: Wayne Twp., bog on Orville Titus farm, 2 miles north of Beaver Dam, LKH and WEB, Sept. 16, 1961.

Listed in "Flora" as reported by Porter from Tioga and Lycoming counties, north-central Pennsylvania.

## GRAMINEAE, Grass Family

\**Agropyron repens* f. *aristatum* (Schumann) Holmberg. Awned form of Couch Grass.

BEDFORD CO.: Wooded roadside, 5.75 miles east-northeast of Hopewell, DB, July 16, 1961.

*Aristida longespica* Poiret. Triple-awned Grass.

BEDFORD CO.: Railroad siding, Saxton station, DB, Oct. 1, 1948.

Listed in "Flora" as to be expected. It occurs in Ohio, West Virginia, and eastern Pennsylvania.

\**Arrhenatherum elatius* f. *flavescens* (P. Nielsen) Holmberg. Form of Tall Oat Grass.

WASHINGTON CO.: Roadside north of Hendersonville, Ellen Mason, June 4, 1955. Naturalized from Europe.

\**Arthraxon hispidus* var. *cryptatherus* (Hackel) Honda.

BEDFORD CO.: Swale, 0.75 miles north of Saxton, DB, Oct. 3, 1957, and Oct. 9, 1961; 1 mile west of Saxton, DB, Oct. 9, 1961.

Genus new for our State records. Naturalized from eastern Asia.

\**Festuca ovina* var. *duriuscula* (Linnaeus) W. D. J. Koch. "Rather hard" variety of Sheep's Fescue.

ALLEGHENY CO.: Frick Park, Pittsburgh, M. Graham Netting, July 30, 1956. Naturalized from Europe.

Listed in "Flora" but not previously collected.

*Poa languida* Hitchcock. Weak Spear Grass.

CAMERON CO.: Clearing in mountain woods, junction of Middle and West branches of Hicks Run, H. A. Wahl, June 10, 1959.

Listed in "Flora" as reported from Bedford Co.

*Uniola latifolia* Michaux. Broad-leaved Spike Grass; Wild Oats.

BEDFORD CO.: Rocky stream border, 3 miles east-southeast of Cooks Mills, DB, Sept. 23, 1962.

Listed in "Flora" as approaching our southwestern border in southern Ohio.

## CYPERACEAE, Sedge Family

*Carex annectens* var. *xanthocarpa* (Bicknell) Wiegand. Yellow-fruited var. of Connecting Sedge.

BUTLER CO.: Along Muddy Creek, 1 mile west of Isle, LKH, July 6, 1960; woods, 2 miles northwest of Fairview, LKH and FHB, June 27, 1961.

HUNTINGDON CO.: Along Route 126, 0.5 mile south of Shy Beaver, WEB, June 5, 1954.

SOMERSET CO.: Along Wills Creek at Fairhope, WEB, June 19, 1954.

*C. bebbii* Olney. Bebb's Sedge.

ERIE CO.: Presque Isle, WEB, Aug. 9, 1952.

Listed in "Flora" as to be expected.

\**C. brunnescens* var. *sphaerostachya* (Tuckerman) Kükenthal.

ELK CO.: Along Route 948 at Mill Creek, WEB and D.H. Krouse, June 21, 1952.

WARREN CO.: Tamarack Swamp bog, 3 miles northeast of Columbus, LKH, May 22, 1948.

WESTMORELAND CO.: Laurel Hill, Wm. R. Van Dersal, May 25, 1930.

From Eurasia.

*C. davisii* Schweinitz and Torrey. Davis's Sedge.

BEDFORD CO.: River bank, 2.25 miles west-northwest of Breezewood, DB, June 14, 1945; stream bank, 1½ miles west of Breezewood, DB, May 21, 1962.

Listed in "Flora" as reported from Centre Co.

\**C. grayii* var. *hispidula* Gray. Variety of Gray's Sedge.

BEAVER CO.: Raccoon Creek, near Pattons Point, OEJ, June 5, 1942.

Listed in "Flora" as to be expected.

*C. haydenii* Dewey. Hayden's Sedge.

FULTON CO.: Along Big Tonoloway Creek at Maryland-Pennsylvania line, WEB, May 19, 1956.

Listed in "Flora" as reported from Lycoming Co.

\**C. lupulina* var. *pedunculata* Gray. Variety of Hop-like Sedge.

BEDFORD CO.: 1.25 miles north of Manns Choice, DB, Sept. 15, 1961; swale, 1¾ miles east of Fishertown, DB, Oct. 1, 1962; border of dam, 0.75 mile south of Schellsburg, DB, Aug. 29, 1962.

\**C. mesochorea* Mackenzie. Midland Sedge.

BEDFORD CO.: Wooded roadside, 3.25 miles southeast of Hopewell, DB, June 26, 1962.

*C. ormostachya* Wiegand.

CAMERON CO.: Along Route 120, 5 miles west-southwest of Emporium, WEB, May 24, 1948.

Listed in "Flora" as reported from Blair Co. by Wiegand.

*C. trichocarpa* Muhlenberg. Hairy-fruited Sedge.

BEDFORD CO.: Wet pasture, ⅛ mile west-southwest of Cypher, DB, June 13, 1961; swale, 1½ miles east of Yellow Creek, DB, May 29, 1962.

Listed in "Flora" as reported from western Pennsylvania.

*Cyperus erythrorhizos* Muhlenberg. Red-rooted Cyperus.

ALLEGHENY CO.: Davis Island, Pittsburgh, Thomas Seal, Sept. 27, 1891.

Listed in key only of "Flora."

\**Eleocharis rostellata* Torrey. Small-beaked Spike Rush.

LAWRENCE CO.: 4 miles east of New Castle, OEJ, Sept. 24, 1950. Also a number of other collections from this locality.

Listed in key only of "Flora."

*Eriophorum spissum* Fernald. Hare's-tail.

ERIE CO.: Wayne Twp., Titus bog, 2 miles north of Beaver Dam, LKH and WEB, June 2, 1962.

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## LEMNACEAE, Duckweed Family

*Lemna perpusilla* Torrey. Minute Duckweed.

BEDFORD CO.: Small pond, 0.5 mile south-southwest of Imler, DB, July 16, 1942.  
Listed in "Flora" as to be expected.

## JUNCACEAE, Rush Family

*Juncus biflorus* Elliott. Small-headed Grass-leaved Rush.

BEDFORD CO.: Roadside ditch, 2.75 miles south-southwest of Chaneyville, DB, Aug. 2, 1951.

Listed in "Flora" as occurring in adjacent Ohio and West Virginia.

## LILIACEAE, Lily Family

*Amianthium muscaetoxicum* (Walter) Gray. Fly-poison; Crow-poison.

CLINTON CO.: Mountain tableland, about 5 miles east of Sinnemahoning, near border of Clinton Co., JB, July 6, 1918, and LKH with WEB, July 20, 1952.

Listed in "Flora" as occurring in West Virginia counties that touch southern Pennsylvania border.

\**Hosta ventricosa* (Salisbury) Stearn. Blue Plantain-lily.

ERIE CO.: In low swampy woods near entrance to Presque Isle, WEB, June 26, 1954, and Aug. 4, 1956.

Naturalized from eastern Asia.

\**Smilax bona-nox* var. *hederaefolia* (Beyrich) Fernald. Ivy-leaved China-brier.

BEDFORD CO.: Along stream bank, 1.75 miles north-northwest of New Buena Vista, DB, July 4 and (fruit) Oct. 28, 1952.

\**S. pulverulenta* Michaux. Greenbrier.

BEDFORD CO.: Wet thicket, 0.25 mile west of Younts Station, DB, Aug. 27, 1962; steep wooded bank, 1.5 miles southeast of Centerville, DB, Sept. 7, 1962.

\**Streptopus roseus* Michaux. Rose Mandarin.

WARREN CO.: Woods, 8.5 miles northeast of Scandia, near New York line, WEB, May 21, 1960.

Mention is made in "Flora" that a couple of varieties occur in our area.

*Trillium cernuum* Linnaeus. Nodding Wake-robin.

CENTRE CO.: State College, H. H. Wigley, 1863-65.

HUNTINGDON CO.: Around large, sandy, bubbling spring, about 3 miles north-northwest of Saltillo, Dorothy L. Pearth, May 14, 1961, and May 12, 1963.

Listed in "Flora" from north-central West Virginia.

\**T. grandiflorum* f. *petalosum* Louis-Marie. Form of Large-flowered Trillium.

GREENE CO.: Along Monongahela River, near Rices Landing, Frank Kormuth, May 1955.

\**Uvularia puberula* Michaux. Bellwort.

FAYETTE CO.: Along Pine Knob Road, south of Hopwood, John F. Lewis, July 25, 1934.

SOMERSET CO.: Buckstown, BHP, July 17, 1905.

Listed in "Flora" (under *U. pudica*), but not as collected in Pennsylvania.

IRIDACEAE, Iris Family

\**Iris sibirica* Linnaeus. Siberian Iris.

CAMBRIA CO.: 4 miles northeast of Patton, Hilary Kline, June 4, 1957.

An escape from cultivation.

*I. verna* var. *smalliana* Fernald. Upland Violet Iris.

FULTON CO.: Along Big Tonoloway Creek, JB, June 1, 1919.

This variety is believed to reach its northern limit in south-central Pennsylvania.

\**I. virginica* var. *shrevei* (Small) E. Anderson. Variety of Southern Blue Flag.

POTTER CO.: In marsh, Burtville, HNM, June 15, 1944.

WARREN CO.: In swamp, North Warren, HNM, June 21, 1944.

Listed in "Flora" as reported from Warren Co.

*Sisyrinchium montanum* var. *crebrum* Fernald. Northern Blue-eyed-grass.

Have from Centre, Fulton, Huntingdon, and McKean counties.

Mention is made in the "Flora" that Pennsylvania is within the range of this variety.

ORCHIDACEAE, Orchid Family

\**Corallorhiza maculata* f. *punicea* (Bartlett) Weatherby and Adams. Reddish-purple form of the Spotted Coral-root.

FOREST CO.: Cook Forest, Mrs. R. R. Jardine, July 29, 1956.

\**C. wisteriana* Conrad. Wister's Coral-root.

ALLEGHENY CO.: "So. Pittsburgh," U. G. Sanger, Apr. 18, 1900.

Listed in "Flora" but not as collected in Pennsylvania.

\**Cypripedium acaule* f. *albiflorum* Rand and Redfield. White-flowered form of Pink Lady's-slipper.

INDIANA CO.: Woods (chiefly white pine and hemlock) about 3 miles northeast of Smithport, LKH and WEB, May 30, 1959. Discovered by Miss Virginia Phelps.

\**Habenaria macrophylla* Goldie. Large Round-leaved Orchid.

CRAWFORD CO.: Cambridge Springs, James Murray, July 15, 1928.

SOMERSET CO.: Vicinity of Somerset, JB, July 1, 1924. Mrs. Verda Yoder reported seeing specimens in Somerset Co. in 1961.

Fernald lists the southern limit of this species as New York.



\**Isotria medeoloides* (Pursh) Rafinesque-Schmaltz. Small Whorled Pogonia.

GREENE CO.: Woods south of Rogersville, JB, May 24, 1922.

#### SALICACEAE, Willow Family

\**Salix interior* var. *pedicellata* (Andersson) Ball. Variety of Sandbar Willow.

ERIE CO.: Presque Isle, OEJ, Sept. 1-2, 1937 (specimen identified by Carleton R. Ball); Presque Isle, WEB, July 3, 1964.

\**S. planifolia* Pursh. Flat-leaved Willow.

ALLEGHENY CO.: Allegheny River front at Oakmont, OEJ, June 18, 1908. Identified by C. R. Ball and marked, "first known occurrence so far south." Range is given by Fernald as mountains of northern New England, north and west to northern Minnesota and Montana.

#### JUGLANDACEAE, Walnut Family

\**Carya ovalis* var. *hirsuta* (Ashe) Sargent. Variety of Sweet Pignut.

CLINTON CO.: Pottersdale to Renovo, OEJ, July 14, 1908.

WESTMORELAND CO.: Roadside east of Trafford, OEJ, Sept. 8, 1934.

\**C. ovalis* var. *obovalis* Sargent. Variety of Sweet Pignut.

BEDFORD CO.: Near Salemville, LKH and WEB, Sept. 15, 1951.

Listed in "Flora" as to be expected.

#### CORYLACEAE, Hazel Family

\**Alnus crispa* (Aiton) Pursh. Green or Mountain Alder.

BEDFORD CO.: 0.5 miles east-northeast of Martin Hill Fire Tower, LKH and WEB, June 16, 1951.

Listed in "Flora" as occurring in mountains of northeastern West Virginia.

*Ostrya virginiana* f. *glandulosa* (Spach) Macbride. Glandulose form of American Hop-Hornbeam.

MCKEAN CO.: Wooded hillside near Port Allegheny, OEJ, June 25, 1939.

SOMERSET CO.: Glade Run bog, 6 miles northwest of Salisbury, Alta Schrock, June 19, 1943.

Listed in "Flora" as reported from McKean Co. by H. N. Moldenke.

#### FAGACEAE, Beech Family

\**Quercus x saulii* Schneider. Hybrid of White and Chestnut oaks.

BEDFORD CO.: Rocky woods, 2 $\frac{3}{8}$  miles north-northwest of Martin Hill Fire Tower, DB, Sept. 27, 1951.

## POLYGONACEAE, Buckwheat Family

*Polygonum careyi* Olney. Carey's Smartweed.

BEDFORD CO.: Moist edge of woods, 0.25 miles southeast of Woodvale, DB, Sept. 3, 1949.

CLEARFIELD CO.: Along Moshannon Creek, 3.5 miles east-southeast of Rolling Stone, on Route 53, LKH, Aug. 27, 1957.

Listed in "Flora" as reported by Miller from Erie County.

\**P. convolvulus* var. *subalatum* LeJeune and Courtois. Variety of Black Bindweed.

CLINTON CO.: Hyner View, near Hyner, LKH and WEB, July 1952.  
Naturalized from Europe.

\**P. opelousanum* var. *adenocalyx* Stanford.

BEAVER CO.: New Galilee, OEJ, Sept. 10, 1906.

*Rumex patientia* Linnaeus. Patience Dock.

MCKEAN CO.: Dry bank along Oswayo Creek, Ceres, J. M. Fogg, Jr., Aug. 15, 1950.

WESTMORELAND CO.: Field, 1 mile east of Greensburg, C. W. Demoise, May 17, 1936.

Listed in "Flora" as to be expected.

Naturalized from Eurasia.

## CHENOPODIACEAE, Goosefoot Family

\**Chenopodium murale* Linnaeus. Nettle-leaved Goosefoot.

ALLEGHENY CO.: Rorys St., Pittsburgh, JB, Aug. 23, 1923.

WARREN CO.: Waste ground, North Warren, HNM, June 29, 1944.

Naturalized from Europe.

Listed in "Flora" as occurring in Franklin Co.

## AMARANTHACEAE, Amaranth Family

\**Amaranthus viridis* Linnaeus. Green Amaranth.

WARREN CO.: Weed in cultivated ground, North Warren, HNM, July 2, 1943.  
Probably native of tropical America.

Listed in "Flora" as reported from Warren Co. by Moldenke.

## CARYOPHYLLACEAE, Pink Family

*Silene antirrhina* f. *deaneana* Fernald. Variety of Sleepy Catchfly.

Have collections from Allegheny, Butler, Crawford, Erie, and Fayette counties.  
From Mexico and South America.

## CERATOPHYLLACEAE, Hornwort Family

\**Ceratophyllum echinatum* Gray. Prickly Hornwort.

CRAWFORD CO.: Vicinity of Hartstown, OEJ, June 9, 1940, and Crystal Lake, OEJ, June 17, 1942.

Listed in "Flora" as to be expected.

### NYMPHAEACEAE, Water-lily Family

#### \**Cabomba caroliniana* Gray. Fanwort.

LAWRENCE CO.: Covering pond, intersection of routes 388 and 422, about 4 miles southeast of New Castle, WEB, Aug. 30, 1952.

### RANUNCULACEAE, Crowfoot Family

#### \**Actaea pachypoda* f. *rubrocarpa* (Killip) Fernald. Red-carpeled form of White Baneberry.

ERIE CO.: Woods, 3 miles southeast of Wattsburg, LKH and WEB, Sept. 9, 1950. Listed in "Flora" as *A. alba* f. *rubrocarpa*, "to be looked for in our region."

#### \**Anemonella thalictroides* f. *rosea* (Michaux) Moldenke. Roseate form of Rue-anemone.

ERIE CO.: Wooded slope, 0.5 mile south of mouth of Elk Creek, Mrs. Richard Collman and Douglas Nagle, May 5, 1962.  
"Occasionally found with species," OEJ.

#### \**Aquilegia canadensis* var. *coccinea* (Small) Munz. Scarlet variety of Wild Columbine.

BEDFORD CO.: Cliff at Lutzville, LKH and FHB, May 6, 1950; along Wills Creek, 3.75 miles south of Hyndman, WEB, May 5, 1951; and along Sideling Hill Creek south of Silvermills, LKH and WEB, May 19, 1951.

FULTON CO.: Shale cliffs along Licking Creek, 1 mile south of Harrisonville, LKH and WEB, May 20, 1950.

#### \**Clematis dioscoreifolia* Leveille and Vaniot. Japanese Clematis.

BEDFORD CO.: Route 30 along Juniata River, east of Everett, WEB, Oct. 13, 1951. Introduced from eastern Asia, and occasionally spreads from cultivation.

#### *Nigella damascena* Linnaeus. Fennel-flower; Love-in-a-mist.

BEDFORD CO.: Abandoned field, 1 mile east-northeast of Wolfsburg, DB, July 27, 1961.

Introduced from Eurasia, and escaping cultivation.

#### \**Ranunculus abortivus* var. *acrolasius* Fernald. Variety of Small-flowered Buttercup.

Have specimens from Allegheny, Cambria, Erie, Forest, Somerset, Venango, Warren, and Westmoreland counties.

#### \**R. micranthus* var. *delitescens* (Greene) Fernald. Variety of Rock Crowfoot.

BEDFORD CO.: Along Route 96, 0.5 mile north of Hyndman, WEB, and D. H. Krouse, May 5, 1951 (one specimen collected by each).

## PAPAVERACEAE, Poppy Family

\**Macleaya cordata* (Willdenow) R. Brown. Plume-poppy.

BUTLER CO.: 1 mile south of Evans City, along Route 528, LKH, Aug. 3, 1946.

WESTMORELAND CO.: In old clearing, Hillside, JB, June 30, 1928.

Introduced from eastern Asia, and spreading from cultivation.

*Papaver dubium* Linnaeus. "Doubtful" Poppy.

BLAIR CO.: Near Williamsburg, D. H. Krouse, June 8, 1950.

FULTON CO.: Along Big Tonoloway Creek, JB, June 1, 1919.

Native of Europe; introduced and escaping in waste places.

Listed in "Flora" but without localities.

## CRUCIFERAE, Mustard Family

\**Brassica juncea* var. *crispifolia* Bailey. Curled Mustard.

ALLEGHENY CO.: Frick Acres, Forbes St., Pittsburgh, H. W. Graham and LKH, June 4, 1925.

Introduced from Eurasia, and escaping from cultivation.

## RESEDACEAE, Mignonette Family

*Reseda lutea* Linnaeus. Yellow Mignonette.

HUNTINGDON CO.: 0.5 mile south of Saltillo, Dorothy Pearth and Nellie Long, August 31, 1963.

Adventive from Europe.

## CRASSULACEAE, Orpine Family

*Sedum sarmentosum* Bunge. Sedum.

ALLEGHENY CO.: On clay bank beside Ohio River at Shields, WEB, June 14, 1958.

Introduced from eastern Asia.

## SAXIFRAGACEAE, Saxifrage Family

\**Ribes cynosbati* f. *inermis* Rehder. Form of Wild Gooseberry.

FAYETTE CO.: 1 mile north of Elliottsville, LKH and WEB, July 28, 1951.

## ROSACEAE, Rose Family

*Amelanchier sanguinea* (Pursh) DeCandolle. Blood-red Juneberry.

BEAVER CO.: Near mouth of Raccoon Creek, OEJ and E. H. Graham, May 17, 1924.

CENTRE CO.: Barrens near Scotia, LKH, July 15, 1960. There is also a sterile specimen, collected in Centre Co. in 1904 by BHP, as mentioned in the "Flora."

\**Filipendula hexapetala* Gilibert. Dropwort.

VENANGO CO.: Scrubgrass Twp., along Allegheny River, 1 mile north of Perry Run, A. J. Deer, May 1904.

An escape from cultivation.

\**Rosa multiflora* Thunberg. Multiflora Rose.

ERIE CO.: Girard Twp., along Elk Creek just east of bridge on Route 8, LKH and WEB, July 28, 1950.

Naturalized from eastern Asia.

\**R. multiflora* var. *cathayensis* Rehder and Wilson.

CRAWFORD CO.: 0.5 mile north of Hydetown along Route 8, LKH and WEB, June 28, 1950.

Introduced, and naturalized, from eastern Asia.

\**R. wichuraiana* Crepin. Memorial Rose.

BEAVER CO.: Along road paralleling Raccoon Creek, between routes 151 and 30, Max Henrici, June 8, 1952.

BUTLER CO.: Field, 2 miles southeast of Portersville, LKH, Aug. 4, 1953.

An escape from cultivation. Mentioned in "Flora" that it will probably be found around old homesteads, or as an adventive.

*Rubus* species. Many of the following *Rubus* are included with the understanding that it is a controversial genus and that some of the names may not be acceptable.

\**Rubus adjacens* Fernald. "Neighboring" Blackberry.

BUTLER CO.: Floodplain of Muddy Creek at Isle, LKH and FHB, June 14, 1950.

CENTRE CO.: Roadside on State Game Lands No. 33, 4 miles southeast of Philipsburg, W. F. Westerfeld, June 23, 1942.

FAYETTE CO.: Laurelville, OEJ, June 24, 1904.

Fernald gives southern limit of range as New York and northern Indiana.

\**R. allegheniensis* f. *calycosus* Fernald (with enlarged calyx). Variety of Allegheny or Mountain Blackberry.

ALLEGHENY CO.: Edgewood, C. C. Mellor, July 6, 1889.

HUNTINGDON CO.: Along abandoned railroad tracks at Coles Summit, about 2.5 miles northwest of Saltillo, Dorothy L. Pearth, June 17, 1962.

*R. avipes* Bailey. Bird-foot *Rubus*.

ELK CO.: Ridgway, OEJ and GKJ, Aug. 21, 1925.

FOREST CO.: Cook Forest, OEJ, June 17-19, 1927.

\**R. bellobatus* Bailey. Kittatinny Blackberry.

CLARION CO.: Red Bank, OEJ, July 21, 1904.

The southern range limit is given by Fernald as New York and northwestern New Jersey. Cultivated and locally spread elsewhere.

*R. canadensis* var. *pergratus* (Blanchard) Bailey. Variety of the Smooth Blackberry.

WESTMORELAND CO.: Chestnut Ridge, vicinity of Hillside, OEJ, June 7, 1919.



\**R. depavitus* Bailey.

WESTMORELAND CO.: Chestnut Ridge, vicinity of Hillside, OEJ, June 7, 1919; Chestnut Ridge, second road south of Loyalhanna Gap, OEJ, July 4, 1920.

Range given by Fernald as New Jersey to northeastern Maryland.

\**R. enslenii* Trattinnick. Enslen's Dewberry.

FAYETTE CO.: Ohiopyle, W. R. Van Dersal, June 21-22, 1930.

*R. floricomus* Blanchard.

ALLEGHENY CO.: Natrona, JAS, May 30, 1901.

Fernald gives range as New England, northern New Jersey, and eastern Pennsylvania to North Carolina.

\**R. illecebrosus* Focke. Strawberry-raspberry.

WESTMORELAND CO.: Farm of Robert Little near Acme, WEB, June 21, 1964.

Introduced from Japan, and sometimes escaping cultivation.

*R. interioris* Bailey.

Have specimens from Allegheny, Armstrong, Blair, Fayette, Huntingdon, Potter, and Westmoreland counties.

*R. noveboracensis* Bailey.

ELK CO.: Along Pennsylvania Railroad just west of Ridgway, Almon N. Rood, June 6, 1945.

Range given by Fernald as south-central New York.

\**R. pauper* Bailey (poor or meagre).

FAYETTE CO.: Thickets, Ohiopyle, JB, June 22, 1929.

WESTMORELAND CO.: Over Chestnut Ridge, second road south of Loyalhanna Gap, OEJ, July 4, 1920.

\**R. plicatifolius* Blanchard. Plaited-leaved Dewberry.

Have from Allegheny, Beaver, Bedford, Erie, Fayette, Huntingdon, Indiana, Mercer, and Westmoreland counties.

Range given by Fernald is Nova Scotia and southeastern Maine to southern Quebec, New York, and Connecticut.

*R. porteri* Bailey.

ERIE CO.: Presque Isle, JB, July 3, 1916, and OEJ, Aug. 24-26, 1905.

Fernald lists occurrence as Pocono Plateau, northeastern Pennsylvania.

*R. roribaccus* (Bailey) Rydberg.

Have from Clearfield, Clinton, Crawford, Erie, Fayette, and Huntingdon counties.

*R. rosa* Bailey.

Have from Allegheny, Beaver, Butler, Erie, Fayette, Jefferson, and Westmoreland counties.

Fernald includes this species under *R. alumnus* Bailey; Gleason and Cronquist include both species under *R. orarius* Blanchard.

\**R. vagulus* Bailey.

FAYETTE CO.: Glade west of Markleysburg, across West Virginia line from Glade Farms, Mr. and Mrs. H. A. Davis, July 22 and Aug. 15, 1950.

Fernald lists occurrence as swamps, West Virginia.

*Spiraea japonica* Linné (the son). Japanese Spiraea.

ALLEGHENY CO.: Head of Darlington Hollow, O'Hara Twp., W. N. Millar, July 7, 1900; along Squaw Run, Fox Chapel area, WEB, July 9, 1949.

Introduced, and naturalized, from Asia.

LEGUMINOSAE, Pea or Pulse Family

\**Colutea cilicica* Boissier. Bladder Senna.

BLAIR CO.: Roadside and open thickets in gap (kettle) of Brush Mountain, south of Altoona, JB, June 16, 1929.

Introduced from Asia Minor and escaping cultivation.

\**Desmodium cuspidatum* var. *longifolium* (Torrey and Gray) Schubert.

Variety of Large-bracted Tick Trefoil.

WESTMORELAND CO.: Swampy lake, 2.5 miles northeast of West Newton, off Route 71, LKH and FHB, July 23, 1953.

\**D. nudiflorum* f. *foliolatum* (Farwell) Fassett. Form of Naked-flowered Tick Trefoil.

SOMERSET CO.: Between Foust's Mills and Hooversville, BHP, Aug. 14, 1875.

\**Lespedeza stipulacea* Maximowicz. Korean-clover.

BEDFORD CO.: 1.5 miles east of Tatesville, along Raystown Branch of Juniata River, LKH and WEB, Sept. 15, 1951.

FULTON CO.: Along Big Tonoloway Creek near Maryland line, WEB, Aug. 11, 1956; along Licking Creek at Dickeys Mountain, LKH, Aug. 30, 1957.

Listed in "Flora" as reported from Centre and Bedford counties.

Introduced, and naturalized, from eastern Asia.

*L. striata* (Thunberg) Hooker and Arnott. Japanese-clover.

FULTON CO.: 2.5 miles southeast of Warfordsburg, along Tonoloway Creek, LKH and WEB, Sept. 13, 1953.

Listed in "Flora" as reported from Bedford Co. by David Berkheimer.

Introduced, and naturalized, from eastern Asia.

\**Lotus corniculatus* Linnaeus. Bird's-foot Trefoil.

Have from Allegheny, Bedford, Lawrence, Potter, Somerset, and Westmoreland counties.

Adventive from Europe.

\**Medicago lupulina* var. *glandulosa* Neilreich. Variety of Black Medick.

Have from Allegheny, Beaver, Cambria, and Clarion counties.

Naturalized from Europe.

\**Strophostyles leiosperma* (Torrey and Gray) Piper. Smooth-seeded Wild Bean.

BEDFORD CO.: Along railroad tracks, near Bedford station, LKH and WEB, Sept. 15, 1951; railroad bed,  $\frac{1}{8}$  mile east of Bedford station, DB, Aug. 20, 1961—"collected first in 1944."

Listed in "Flora" as from Muskingum Co., Ohio, and as reported from Bedford Co. by Berkheimer. Ranges westward.

#### GERANIACEAE, Geranium Family

*Geranium bicknellii* Britton. Bicknell's Geranium.

CLINTON CO.: Hyner View above Route 120, near Hyner, LKH and WEB, July 19, 1952.

\**G. carolinianum* var. *confertiflorum* Fernald (with crowded flowers). Variety of Cranesbill.

Have specimens from Allegheny, Bedford, Fulton, Somerset, and Westmoreland counties.

Listed in "Flora" as occurring in northern West Virginia.

\**G. pratense* Linnaeus.

WASHINGTON CO.: 2.5 miles north of Finleyville, Dennis Gondella, 1962.

Fernald lists range southward as "rarely to Mass. and N. Y."

Naturalized from Europe.

#### ZYGOPHYLLACEAE, Calthrop Family

\**Tribulus terrestris* Linnaeus. Calthrop or Puncture-weed.

ALLEGHENY CO.: Banks of Allegheny River, below Aspinwall, JB, Aug. 12, 1922.

Naturalized from Old World.

#### POLYGALACEAE, Milkwort Family

\**Polygala paucifolia* f. *alba* Wheelock. White form of Fringed Polygala.

WARREN CO.: Woods, 8.5 miles northeast of Scandia, near New York line, WEB, May 21, 1960.

#### CALLITRICHACEAE, Water Starwort Family

*Callitriche stagnalis* Scopoli.

BEDFORD CO.: Wet ditch, 1.25 miles northwest of Osterburg, DB, Sept. 3, 1951.

Naturalized from Europe.

#### AQUIFOLIACEAE, Holly Family

\**Nemopanthus mucronata* f. *chrysocarpa* (Farwell) Fernald. Yellow-fruited form of Mountain-holly.

ERIE CO.: Titus bog, 2 miles north of Beaver Dam, LKH and WEB, July 28, 1962.

## CELASTRACEAE, Staff-tree Family

\**Pachystima canbyi* Gray. Canby's Pachystima.

BEDFORD CO.: Near Lutzville, LKH and WEB, Aug. 6, 1949, and D. H. Krouse, May 6, 1950.

Fernald gives range as mountains of western Virginia, West Virginia, Kentucky, and Highland and Adams counties, Ohio.

Mentioned in "Flora" as reported by Berkheimer in Bedford Co.

## BALSAMINACEAE, Touch-me-not Family

\**Impatiens pallida* f. *dichroma* Steyermark. Form of Pale Touch-me-not (white with yellow spur).

WARREN CO.: Along edge of stream, Warren, HNM, July 24, 1943.

## VITACEAE, Vine Family

\**Parthenocissus inserta* (Kerner) K. Fritsch. "Inserted" Virginia Creeper.

Have from Allegheny (poor specimen), Cameron, Elk, and Erie counties.

Jennings mentions that it probably occurs along our northern border.

## MALVACEAE, Mallow Family

\**Hibiscus moscheutos* Linnaeus. Rose-mallow; Mallow-rose.

SOMERSET CO.: Route 40 at intersection with Youghiogheny River, WEB, Aug. 27, 1947. "No habitation near."

Listed in "Flora" as occurring in northeastern West Virginia.

Fernald gives range as from Florida north to West Virginia, southern Ohio, and southern Indiana.

## VIOLACEAE, Violet Family

\**Viola appalachensis* L. K. Henry. Mat-forming Blue Violet.

SOMERSET CO.: Along Kimberly Run, 2.5 miles southeast of Somerset along Route 219, LKH and WEB, May 13, 1950 (type locality), and 7 other localities in county.

\**V. conspersa* f. *masonii* (Farwell) House. White form of Dog Violet.

INDIANA CO.: Along Black Lick Creek at Heshbon, LKH, May 17, 1956.

WESTMORELAND CO.: 4.5 miles south of Bolivar, LKH, May 17, 1956.

Listed in "Flora" but not previously collected.

\**V. cucullata* f. *albiflora* Britton. White-flowered form of the Marsh Blue Violet.

ERIE CO.: Sphagnum bog, 2.5 miles northeast of Union City, WEB, June 4, 1949.

WESTMORELAND CO.: Top of Chestnut Ridge, along Route 180, 3 miles east of Lycippus, WEB, May 12, 1955.

\**V. fimbriatula* f. *glabrata* Pennell. Form of Ovate-Leaved Violet.

LAWRENCE CO.: Muddy Creek Falls, near mouth of Muddy Creek, WEB, Apr. 30, 1955.

\**V. pallens* var. *subreptans* Rousseau. Variety of Pale Violet.

CLARION CO.: Vicinity of Mill Creek, 4 miles southwest of Fisher, LKH, Aug. 24, 1955.

*V. rostrata* f. *phelpsiae* Fernald. White form of Long-spurred Violet.

MERCER CO.: Along North Deer Creek, 1 mile south of Carlton, LKH and FHB, May 13, 1963.

POTTER CO.: Vicinity of Cross Fork, Herbert Graffius, May 18, 1958.

SOMERSET CO.: 1 mile west of Hillsboro, along tributary of Shale Creek, LKH and FHB, May 13, 1953.

\**V. septentrionalis* f. *alba* Marie-Victorin and Rousseau. White form of the Northern Blue Violet.

WARREN CO.: 2.6 miles southwest of Scandia, LKH and WEB, May 23, 1959; mixed woods, 8.5 miles northeast of Scandia, 1.4 miles south of New York state line, LKH and WEB, May 23, 1959.

#### CACTACEAE, Cactus Family

*Opuntia compressa* (Salisbury) Macbride. Prickly-pear.

BEDFORD CO.: Shale barren, 1.4 miles south of Hewitt, LKH and WEB, June 16, 1951.

HUNTINGDON CO.: Shale outcrop at Pogue, along Aughwick Creek, Dorothy E. Long, July 6, 1952.

#### ONAGRACEAE, Evening-primrose Family

\**Oenothera biennis* var. *hirsutissima* Gray. Variety of Biennial Evening-primrose.

GREENE CO.: 3 miles southeast of Ryerson, LKH and WEB, July 13, 1954.

#### UMBELLIFERAE, Parsley Family

*Conioselinum chinense* (Linnaeus) Britton, Sterns, and Poggenberg. Hemlock-parsley.

HUNTINGDON CO.: T. C. Porter, Aug. 1868; Spruce Creek, T. C. Porter, about 1850 (poor specimen); Birmingham, Laurel Springs, Thomas Seal, Aug. 25, 1888 (immature specimen).

*Ligusticum canadense* (Linnaeus) Britton. Angelico.

BEDFORD CO.: In woods along small stream, 1.4 miles east of Breezewood, LKH and WEB, July 30, 1952.

Listed in "Flora" as reported by Porter.



## ERICACEAE, Heath Family

- \**Rhododendron arborescens* var. *richardsonii* Rehder. Variety of Smooth Azalea.

FAYETTE CO.: Ohiopyle, JAS, June 29, 1902, and BHP, June 7, 1908.

SOMERSET CO.: Buck Swamp, 2.5 miles west of Shanksville, LKH, July 8, 1948.

WESTMORELAND CO.: Along sandy floodplain of island in Loyalhanna Gorge, between Kingston and Long Bridge, OEJ, June 8, 1912.

- \**R. nudiflorum* x *roseum*. Hybrid of Pink Azalea and Mountain-honeysuckle.

Have specimens from Allegheny, Bedford, Crawford, and Jefferson counties.

- Vaccinium angustifolium* var. *hypolasium* Fernald. Variety of Low Sweet Blueberry.

Have from Allegheny, Cambria, Centre, Clinton, Elk, Somerset, and Westmoreland counties.

## OLEACEAE, Olive Family

- \**Ligustrum obtusifolium* Siebold and Zuccarini. Obtuse-leaved Privet.

HUNTINGDON CO.: Along Route 350, 1.5 miles southeast of Birmingham, LKH, Aug. 11, 1958.

Introduced from Japan, and escaping cultivation.

## GENTIANACEAE, Gentian Family

- \**Centaurium umbellatum* Gilibert. Centaury.

ERIE CO.: Siegerswald, 2 miles northwest of North East, OEJ, Aug. 2, 1927.

Naturalized from Europe.

- \**Gentiana andrewsii* f. *albiflora* Britton. White form of Closed Gentian.

BEDFORD CO.: 5.25 miles south-southwest of Beans Cove Church, DB, Oct. 7, 1962.

- \**Sabatia angularis* f. *albiflora* (Rafinesque-Schmaltz) House. White-flowered form of Rose-pink.

FULTON CO.: Along Big Tonoloway Creek near Maryland line, WEB, Aug. 11, 1956.

## ASCLEPIADACEAE, Milkweed Family

- \**Asclepias viridiflora* var. *linearis* (Gray) Fernald. Variety of Green Milkweed.

BEDFORD CO.: Shale barren, 1.75 miles south-southwest of Hewitt, LKH, Aug. 6, 1949.

## CONVOLVULACEAE, Morning-glory Family

- \**Convolvulus japonicus* Thunberg. Japanese Bindweed.

ALLEGHENY CO.: Glenshaw, JB, July 29, 1918; Sandy Creek, along Allegheny River, BHP, July 5, 1904.

LAWRENCE CO.: McConnells Mill, JB, July 18, 1925.

WASHINGTON CO.: Monongahela City, on riverbank, JAS, July 10, 1900.  
Native of Japan, and escaping cultivation.

### BORAGINACEAE, Borage Family

\**Heliotropium amplexicaule* Vahl. Heliotrope.

ERIE CO.: Bogg's Run, Gustave Guttenberg, July 28, 1879. Specimen small.  
Naturalized from South America.

*H. europaeum* Linnaeus. European Heliotrope.

ALLEGHENY CO.: On fine slag, Continental Can Company, West Mifflin, Route 885, Harry Roslund, Aug. 17, 1961.  
Naturalized from Europe.

### LABIATAE, Mint Family

\**Mentha longifolia* var. *mollissima* (Borkhausen) Rouy. Variety of European Horse Mint.

GREENE CO.: 5 miles northeast of Graysville, LKH and WEB, Oct 9, 1954.  
Introduced from Europe.

\**Prunella vulgaris* var. *lanceolata* f. *rhodantha* Fernald. Rose-flowered form of Lanceolate Heal-all.

ALLEGHENY CO.: Marsh between Crafton and Ingram, Ellen Mason, Oct. 6, 1945.

\**Satureja acinos* (Linnaeus) Scheele. Mother-of-Thyme.

CENTRE CO.: Calcareous hillside, 2 miles southwest of Spring Mills, LKH, July 15, 1960.  
Naturalized from Europe.

\**Stachys palustris* var. *pilosa* (Nuttall) Fernald. Variety of Woundwort.

WESTMORELAND CO.: Presbyterian Church camp, 2 miles north of Ligonier, Samuel Chamberlain, July 14, 1963.  
Adventive from west.

*Thymus serpyllum* Linnaeus. Creeping Thyme.

MCKEAN CO.: 2 miles west-southwest of Clermont, J. M. Fogg, Jr., Aug. 17, 1950.  
Naturalized from Europe.

### SOLANACEAE, Nightshade Family

\**Physalis pubescens* var. *integrifolia* (Dunal) Waterfall. Variety of Ground-cherry.

Have from three locations in Allegheny Co. and from Beaver and Greene counties.

## SCROPHULARIACEAE, Figwort Family

- \**Mimulus ringens* f. *albiflorus* Moldenke. White form of Monkey-flower. (TYPE)

WARREN CO.: Brookside, North Warren, HNM, July 17, 1944.

## PLANTAGINACEAE, Plantain Family

- \**Plantago major* f. *rosea* (Decaisne) Prah. Form of the Common Plantain.

ALLEGHENY CO.: Natrona, JAS, 1895.

WESTMORELAND CO.: Jeannette, A. E. Ortman, June 28, 1904.

This species has been naturalized from Eurasia and probably from parts of North America.

- \**P. media* Linnaeus. Hoary Plantain.

ERIE CO.: Erie, the Rev. Denise, in JB collection, June 16, 1923.

Adventive from Eurasia.

## RUBIACEAE, Madder Family

- Galium erectum* Hudson. Erect Bedstraw.

BEDFORD CO.:  $\frac{3}{8}$  mile south of Cessna, DB, June 27, 1962.

Naturalized from Europe.

## CAPRIFOLIACEAE, Honeysuckle Family

- \**Symphoricarpos albus* (Linnaeus) Blake. Snowberry.

Have from Bedford, Huntingdon, and Washington counties.

Listed in "Flora" as to be expected.

## CAMPANULACEAE, Bellflower or Bluebell Family

- \**Lobelia spicata* var. *leptostachys* (A. DeCandolle) Mackenzie and Bush. Variety of Pale-spiked Lobelia.

GREENE CO.: 3.5 miles southwest of Deep Valley, LKH and FHB, Aug. 1, 1951.

- \**L. spicata* var. *scaposa* McVaugh. Scapose variety of Pale-spiked Lobelia.

BEDFORD CO.: Wooded roadbank,  $3\frac{5}{8}$  miles east-southeast of Hopewell, DB, July 13, 1960; 1.25 miles southwest of Inglesmith, DB, June 29, 1961; moist pasture, 3.25 miles southeast of Hopewell, DB, June 26, 1962.

Listed in "Flora" as reported from Fulton and Franklin counties.

## COMPOSITAE, Composite Family

- Artemisia ludoviciana* var. *gnaphalodes* (Nuttall) Torrey and Gray.

Variety of Western Mugwort.

WASHINGTON CO.: 4 miles south of Claysville, WEB, Oct. 1, 1949.

Native of the prairies; naturalized eastward.

Listed in "Flora" as reported from Erie Co., by Miller, as *A. ludoviciana* Nuttall.

\**A. pontica* Linnaeus. Roman Wormwood; Hungarian Wormwood.

CENTRE CO.: Bear Meadows, JB, June 3, 1917.

Naturalized from southern Europe.

\**Aster puniceus* f. *candidus* Fernald. Form of Purple-stemmed Aster.

LAWRENCE CO.: 10 miles southeast of Mercer on the Plaingrove road, LKH and OEJ, Sept. 5, 1951.

\**Bidens polylepis* var. *retrorsa* Sherff. Variety of Many-scaled Bur-marigold.

ALLEGHENY CO.: Along Mt. Pleasant Rd., east of Riverview Park, Pittsburgh, WEB, Oct. 15, 1957.

Listed in "Flora" as to be expected.

This represents an eastern extension of the range as given in Fernald, "local, O. and Ind. to Mo."

*Carduus acanthoides* Linnaeus. Thistle.

BEDFORD CO.: Roadbank, 0.5 mile west-northwest of Wolfsburg, DB, Aug. 27, 1962.

BLAIR CO.: Sinking Creek Valley, 1 mile southwest of Culp, LKH, Aug. 11, 1958.

WARREN CO.: Along Brokenstraw Creek, between Spring Creek and Pittsfield, Mrs. E. B. Burgess, 1938.

Listed in "Flora" as reported for Centre and Bedford counties.

Adventive from Europe.

\**Cirsium arvense* var. *mite* Wimmer and Grabowski. Variety of Canada Thistle.

ALLEGHENY CO.: McCormack Rd., Robinson Twp., Mrs. Ellen Mason, July 2, 1960.

Naturalized from Europe.

\**Erigeron pusillus* Nuttall. Small Fleabane.

BEDFORD CO.: Old field north of Centerville, OEJ and George B. Parker, Sept. 13, 1919.

Introduced from tropical America.

\**Grindelia squarrosa* (Pursh) Dunal. Gumweed.

SOMERSET CO.: Kooser State Park, near Bakersville, Mrs. K. G. Kutchka, Sept. 1962.

\**Hieracium vulgatum* Fries. Common Hawkweed.

ALLEGHENY CO.: Along Northminster St., Northside, Pittsburgh, WEB, July 7, 1950.

Naturalized from Europe.

\**Lactuca canadensis* var. *latifolia* f. *exauriculata* Wiegand. Form of the Broad-leaved variety of Wild Lettuce.

ELK CO.: 2 miles north of Medix Run Station, OEJ, Aug. 26, 1925.

\**L. hirsuta* Muhlenberg. Hirsute Wild Lettuce.

BEDFORD CO.: Limestone woods, Lutzville, WEB, Aug. 13, 1955.

Listed in "Flora" as reported from Elk Co.

\**L. hirsuta* var. *sanguinea* (Bigelow) Fernald.

BEDFORD CO.: Lincoln Highway, near Juniata Crossing, JB, Oct. 16, 1920.

ELK CO.: Ridgway, OEJ, Aug. 21, 1925.

FAYETTE CO.: Ohiopyle, JAS, Sept. 1, 1900.

Listed in "Flora" as reported by Berkheimer in Bedford Co.

\**Leontodon hastilis* var. *vulgaris* W. D. J. Koch. Hawkbit variety.

ERIE CO.: About 3.5 miles northeast of Union City, WEB, July 25, 1964.

Adventive from Europe.

\**Liatris spicata* f. *albiflora* Britton. White-flowered form of Blazing-star.

BUTLER CO.: 3.5 miles northwest of West Sunbury, Wm. F. Kummer, Aug. 11, 1960.

\**Matricaria chamomilla* Linnaeus. Sweet False Chamomile.

BEAVER CO.: Beside barn, near cemetery, Ambridge, H. W. and E. H. Graham, June 10, 1923.

CAMERON CO.: Geo. B. Stevenson Dam, Mrs. Charles E. Shaw, Oct. 2, 1960.

WASHINGTON CO.: Along Chartiers Creek east of Hendersonville, LKH, June 4, 1947.

Listed in "Flora" but not as collected.

Naturalized from Europe.

*Picris hieracioides* Linnaeus. Hawkweed; Picris.

ALLEGHENY CO.: Glenshaw, JB, Sept. 11, 1918.

BEDFORD CO.: Vacant lot, Bedford, OEJ, Sept. 14, 1919; along highway in barren fields, near southern border of county, JB, Sept. 28, 1928; roadside, 3¾ miles southeast of Cooks Mills, DB, Sept. 23, 1962.

Listed in "Flora" as reported from Allegheny and Bedford counties.

Adventive from Europe.

\**Prenanthes racemosa* Michaux. Racemose Rattlesnake-root.

LAWRENCE CO.: Plaingrove bog, Plain Grove Twp., WEB, Sept. 19, 1959.

*P. serpentaria* Pursh. Gall-of-the-earth.

BEDFORD CO.: 3 miles south-southwest of Bedford Springs, LKH and WEB, Sept. 13, 1952.

Listed in "Flora" as reported by Berkheimer.

\**Rudbeckia laciniata* var. *ampla* (Nelson) Cronquist. Variety of Wild Goldenglow.

SOMERSET CO.: Along Pennsylvania Turnpike, about 1 mile west of Somerset Interchange, WEB, July 21, Aug. 25, and Oct. 13, 1962.



- \**Senecio aureus* var. *semicordatus* (Mackenzie and Bush) Greenman.  
Variety of Golden Ragwort.

BUTLER CO.: Stone House Prairie, along Route 8 at intersection of Route 173, OEJ, June 7, 1955.

- \**S. viscosus* Linnaeus. Sticky Groundsel.

ELK CO.: Along Pennsylvania Railroad tracks, near Eagle Valley Tannery, Ridgeway, Almon N. Rood, Oct. 12, 1952.

Naturalized from Europe.

- \**Solidago purshii* Porter. Pursh's Goldenrod.

CRAWFORD CO.: Pymatuning Swamp, BHP, Aug. 25, 1887; swampy lands along east-west road, 3 miles south of Spartansburg, John Wurdack, Jr. Aug. 30, 1940.

- \**Xanthium oviforme* Wallroth. Egg-shaped Cocklebur.

ERIE CO.: Presque Isle, JAS, Sept. 9-11, 1900.

Adventive from western United States.

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PALEONTOLOGY AND GEOLOGY OF THE BADWATER  
CREEK AREA, CENTRAL WYOMING

## Part 1. History of Field Work and Geological Setting

CRAIG C. BLACK AND MARY R. DAWSON

Section of Vertebrate Fossils  
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## INTRODUCTION

In 1962 the Section of Vertebrate Fossils of Carnegie Museum began the exploration of Tertiary deposits and the collection of Tertiary fossils along Badwater Creek in the northeastern part of the Wind River Basin, Natrona and Fremont counties, Wyoming. Field work and study of the collections will probably occupy several more years, but the significance of the materials and information obtained so far seems to warrant publication of results as individual groups of the faunas and various aspects of the geology are studied. Part 1 of this series is a general introduction to the field work and setting of the faunas. Part 2 describes the only known late Eocene multituberculate. Part 3 describes a new species of apatemyid.

## SCOPE OF THE SERIES

In recent years there has been an increased interest in the evolutionary changes in various mammalian groups during the late Eocene, an interval lasting from about forty-five to about thirty-six million years ago. This interest led to such work as Gazin (1955, 1958) on artiodactyls and primates, Radinsky (1963) on tapiroids, Dawson (1966) on rodents, and to many studies on late Eocene faunas now in progress in both North America and Eurasia. As Simpson (1965) has remarked, "Paleontology is necessarily a slow science, costly in labour and time in each phase from discovery through collection and laboratory preparation to comparison, identification, and analysis." Nevertheless, as many colleagues are working on similar problems, the authors feel it is perhaps unwise to delay presenting information as it becomes available, even though they believe their knowledge is incomplete. The present series of papers has accordingly been initiated.

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The papers in this series on the paleontology and geology of the Badwater Creek area will include a number of parts. Although the authors cannot predict the order in which studies will be completed, the first reports will probably be descriptive and systematic treatments of the vertebrate groups present in the various faunas. When the composition of each fauna is well established, analysis of entire assemblages, including invertebrates, from the various localities will be possible. Geological work including more detailed mapping and sedimentation studies is also planned.

#### HISTORY OF INVESTIGATION

Our interest in the late Eocene and thus in the Badwater area stems from a series of informal discussions during 1960 and 1961 on problems of small mammal evolution and the dearth of information on this subject for the late Eocene and early Oligocene. A recent evaluation of previously known information on this period (Black and Dawson, 1966) has demonstrated how critical in mammalian history the late Eocene was, not only for small mammals but for eutherians in general.

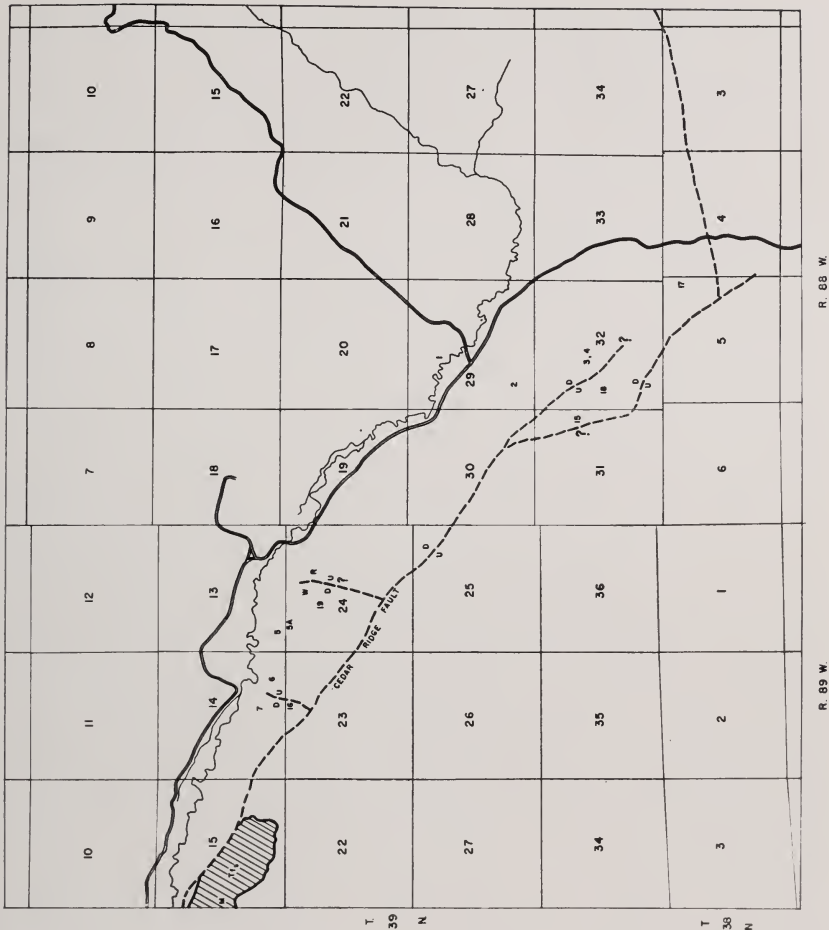
The first result of these discussions was an endeavor to assess the potential of the then known late Eocene vertebrate localities for further work using a washing technique (McKenna, 1962) for recovering micro-mammalian remains. One of the most promising localities appeared to be in the area along Badwater Creek in the northeastern Wind River Basin. Wood, Seton, and Hares (1936) were the first to collect vertebrates in this region and to recognize the late Eocene age of the fossils. The mammalian specimens discovered were *Amyrnodon advenus* and cf. *Telmatherium cultridens*. After this initial discovery little attention was given to the area by vertebrate paleontologists until Tourtelot (1946, 1953, 1957) began geological investigations for the U. S. Geological Survey. In the course of his work vertebrate material was discovered at a number of localities along Badwater Creek and also farther to the west along Dry Creek in Fremont County.

Partly as a result of Tourtelot's discoveries, the Third Annual Field Conference of the Society of Vertebrate Paleontology included the Badwater Creek—Lysite Mountain area in its itinerary. In the Guidebook

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Figure 1. Sketch map showing position of Tourtelot's and the authors' localities along Badwater Creek in Natrona Co., Wyoming. Nos. 1-7, 15-16 used by Tourtelot (1957). Nos. 5A, 17-19, and W (Wood), M (Malcolm), and R (rodent) refer to localities discovered since 1962.





for the Conference, Tourtelot (1948) discussed "middle and upper Eocene rocks" along Badwater Creek and farther north on Lysite Mountain, and listed the vertebrate and invertebrate fossils known at that time from these areas. At the close of the field conference, A. E. Wood of Amherst College returned to one of Tourtelot's localities where he made a collection that included 14 species of mammals, nine being micromammals (Wood, 1949).

In 1956, Gazin published on 28 species of mammals from the Badwater fauna. This study was based upon collections made by Tourtelot in 1944, 1945, and 1948, and by Gazin in 1946 and 1953. Geology of the area was reported by Tourtelot (1957), who referred the upper Eocene deposits to Love's (1939) Tepee Trail Formation. Two members were recognized, a lower "green and brown member" and an upper Hendry Ranch Member. A. E. Wood returned to the area in 1957 but made no collections and Gazin has worked there briefly a few times since 1956. But, to the authors' knowledge, no significant collections were made between 1953 and the time they began their work in 1962. At that time they and Peter Robinson of the University of Colorado Museum spent eight days prospecting in the Hendry Ranch Member between the Cedar Ridge fault and Badwater Creek, visiting most of Tourtelot's vertebrate fossil-bearing localities in the region. Small collections were obtained from his localities 5, 6, and 7 (fig. 1) and about forty pounds of matrix from locality 6 was washed. The authors were greatly encouraged by the results of this preliminary work and decided that a large-scale washing program would yield significant results. Therefore, in June, 1963, a joint Carnegie Museum—University of Colorado field crew of some dozen members began washing operations at locality 5 (fig. 1). The group modified the washing technique of McKenna (1962) to their needs, washing and drying the highly bentonitic matrix in relatively tightly woven burlap sacks that would retain teeth less than 0.5 mm. in length. Preliminary sorting of concentrates indicated a loss, when screens were used, of some thirty to forty per cent of the isolated teeth and bones occurring in the deposit. This fraction was retained when washing was done in finely woven burlap sacks. The fraction retained consisted of isolated rodent and insectivore teeth of several species plus isolated teeth of one marsupial, one primate, and one multituberculate.

Further prospecting led to discovery of locality 5A, and during the 1963 season about twenty tons of matrix from localities 5 and 5A were processed. It was during this field season that the first late Eocene

multituberculate tooth was found (Robinson, *et. al.*, 1964) while prospecting at locality 5. It was also during the summer of 1963 that a late Paleocene fauna was discovered just east of the Natrona-Fremont County line and south of Badwater Creek in what is now considered the Shotgun Butte Member of the Fort Union Formation (Keefer, 1964).

Prospecting in 1963 and 1964 led to discovery of several other vertebrate-bearing localities in addition to those listed by Tourtelot. Two of these, nos. 17 and 18, have yielded materials which suggest a fauna possibly of late Lost Cabinian age. The locality from which A. E. Wood (1949) obtained his collection was also prospected. This is not Tourtelot's locality 15, as reported, and is here termed "Wood locality." Tourtelot's locality 15 is in the NE $\frac{1}{2}$ sec. 31, T. 39N., R. 89W., while the Wood locality is in NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 24, T. 39N., R. 89W. In 1964 20 tons of matrix from locality 6 and the Wood locality were processed as were 2 tons of matrix from the late Paleocene county line locality [named "Malcolm's locality" (fig. 1) after Malcolm C. McKenna, discoverer of the first fossil mammals there.].

During the summer of 1963 a fourth faunal horizon was discovered in tan sandy silts which unconformably overlie the Tepee Trail Formation in the vicinity of the Wood locality and of localities 5, 6, and 7. This horizon was not worked extensively until 1965 when a small productive lens, locality 19, was discovered near the Wood locality but stratigraphically considerably above it. Preliminary analysis of this fauna indicates a late Oligocene or earliest Miocene age (included are *Palaeolagus*, *Eumys*, *Prosciurus*, *Proheteromys*, *Pseudotheridomys* (?), *Peratherium*, and an insectivore). In 1965 one month was spent working this and the previously known localities, and about a ton of matrix from locality 17 was washed.

Collections of 1963, 1964, and 1965 now total several thousand specimens including mollusks, reptiles, and mammals. There still remains a backlog of unsorted concentrate which represents approximately one-third again as much as the total processed to date. Of the mammalian specimens so far obtained, roughly 90 per cent are isolated teeth. A sufficient number of jaw and maxillary fragments have been recovered, however, to warrant some hope that quarrying will produce additional associations, and quarrying operations are planned for future field work.

Thus far our work (Robinson, *et al.*, 1964) has added between twenty-eight and thirty species to the previously recognized 28 (Table 1) that were discussed by Gazin (1956). Of the additions, 18 genera are new to the North American late Eocene. Some of the preliminary

determinations of the 1964 report (Robinson, *et al.*) and the fauna listed in Table 1 will undoubtedly be modified by later work as more complete material is obtained. However, it is now obvious that the late Eocene faunas recovered from the Hendry Ranch Member of the Tepee Trail Formation are the most varied and the richest of any North American late Eocene faunas known. In addition, the other newly discovered faunal horizons north of Cedar Ridge along Badwater Creek are of significance both faunally and geologically.

#### GENERAL GEOLOGICAL SETTING

The area from which the numerous Badwater faunas have been obtained is located in the northeastern part of the Wind River Basin along the southern edge of the Big Horn Mountains and the southeastern end of the Owl Creek Mountains in Fremont and Natrona Counties, Wyoming. All but one of the localities considered here lies to the south of Badwater Creek between the creek and the Cedar Ridge fault (fig. 1). To quote from Tourtelot (1957: 1-2), "The younger Eocene strata consist of resedimented andesitic volcanic rocks and form a narrow belt adjacent to the mountains, and in part within them. These volcanic-rich strata are separated from the Wind River formation of early Eocene age on the south by a normal fault of large displacement."

Tourtelot recognized two members of the Tepee Trail Formation, a lower "green and brown" member and above this the Hendry Ranch Member. The rocks of the Hendry Ranch Member were considered by Tourtelot to be generally finer grained than those of the green and brown member. The green and brown member is characterized as being (Tourtelot, 1957: 7), "rich in volcanic material and zones of conglomerate . . . and hard tuff (?) embedded in a coarse-grained matrix of similar volcanic material." Siliceous fresh-water limestones are prominent in the upper part of the green and brown member. The Hendry Ranch Member is described as being made up of gray and greenish-gray claystone and siltstone and tan siltstone rich in volcanic material.

At the western end of Cedar Ridge, Tourtelot recognized a small area of vertical to overturned beds of the Fort Union Formation. These are now (Keefer, 1964) considered to be part of the Shotgun Butte Member of the Fort Union Formation. Vertebrate fossils have been recovered from these strata [Malcolm's (M) locality, fig. 1].

All other localities worked by the authors since 1962 are in the Tepee Trail Formation. Tourtelot regarded the Tepee Trail strata as deposits



of both middle and late Eocene time. Two faunas, those from localities 17 and 18, are of a late early Eocene aspect. *Phenacodus*, a genus unknown after Lost Cabinian time, occurs in both. Unfortunately, neither locality has yet produced sufficient material of other groups for an accurate age determination.

Localities 1, 2, 3, 4, 17, and 18 all occur in the green and brown member as shown by Tourtelot (1957), fig. 2). No vertebrate specimens have been recovered from 1, 2, 3, or 4 that would suggest an age assignment different from that of the Hendry Ranch faunas. However, very little diagnostic material has been obtained from localities 1, 2, 3, and 4 as yet.

All other localities are in the Hendry Ranch Member as mapped by Tourtelot. These include localities 5, 5A, 6, 7, 16, 19, R, and W. Faunas from these localities, except 16 and 19, are essentially the same although some minor differences in composition are suggested. Localities 16 and 19 are in the silts considered by Tourtelot (1957: 13) to be the uppermost portion of the Hendry Ranch Member. Field work in 1964 and 1965 disclosed that these tan silts unconformably overlie the gray and greenish-gray strata of the Hendry Ranch Member and that they contain a fauna of much later aspect. Mammals recovered from both localities 16 and 19 indicate a late Oligocene to earliest Miocene age for these rocks.

#### FUTURE WORK

Field work in the future will be devoted to recovery of larger collections from the late early Eocene and the late (?) Oligocene localities; to development of quarries at localities W, 5, 5A, 6, and 7 in the hope of securing more complete materials; and to work in the Dry Creek area to the west.

Various groups such as insectivores, primates, and rodents are now being studied and reports on individual elements of the faunas should be completed soon. Analysis of faunal variations among localities within the Hendry Ranch Member will be made. Certain differences are already apparent in gross aspect indicating possibly differing ecological conditions within this limited area of deposition.

Geological studies will continue during the summer of 1966. The Tertiary structural history of this region is much more complex than heretofore realized and this must be unraveled. Petrographic studies will be made of rock samples from each vertebrate producing locality. These may shed some light on differing depositional environments which



would influence animal distribution. Finally, an attempt will be made to relate Tepee Trail sediments along Badwater Creek to those to the north and west toward and into the type area of the Formation (Love, 1939).

#### ACKNOWLEDGEMENTS

Genera of Marsupialia, Insectivora, Dermoptera, and Primates listed in Table 1 were supplied by Peter Robinson of the University of Colorado Museum, who is studying these elements of the Badwater faunas. The authors would also like to thank him for his help during the 1962 and 1963 field seasons. Work was supported by NSF grants GB-1266 and GB-4089 and by grants from the Childs Frick Corporation and the Gulf Oil Corporation.

TABLE 1

Late Eocene mammals, Hendry Ranch Member, Tepee Trail Formation, as now known from localities 5, 5A, 6, 7, Rodent (R), and Wood (W), shown in figure 1.

Multituberculata	Soricidae
Ptilodontidae	<i>Domnina</i> °
<i>Parectypodus</i> °	Talpidae
Marsupialia	?talpid sp.°
Didelphidae	Apternodontidae
<i>Peratherium</i>	? <i>Apternodus</i> °
<i>Nanodelphys</i> °	<i>Oligoryctes</i> °
Mammalia inc. sed.	Dermoptera
<i>Thylacaelurus</i>	Plagiomenidae
Insectivora	plagiomenid°
Leptictidae	Primates
leptictid sp.	Omomyidae
Pantolestidae	<i>Chumashius</i>
pantolestid sp.°	<i>Macrotarsius</i> °
Apatemyidae	Anaptomorphidae
<i>Apatemys</i> 2 spp.	<i>Uintasorex</i> °
Nyctitheriidae	? <i>Anaptomorphus</i> °
? <i>Nyctitherium</i> °	Paromomyidae
? <i>Micropternodus</i> °	paromomyid sp.°
<i>Geolabis</i> °	Lagomorpha
Erinaceidae	Leporidae
? <i>Scenopagus</i>	<i>Mytonolagus</i>
? <i>Entomolestes</i> °	Rodentia
<i>Ankylodon</i> °	Paramyidae
? <i>Proterixoides</i> °	<i>Ischyrotomus</i>

<i>Leptotomus</i>	Brontotheriidae
<i>Rapamys</i>	brontotheriid sp.
<i>Microparamys</i>	Eomoropidae
? <i>Plesispermophilus</i> *	? <i>Grangeria</i> *
Cylindrodontidae	Helaletidae
? <i>Pseudocylindrodon</i> *	<i>Dilophodon</i>
Sciuravidae	<i>Colodon</i>
<i>Sciuravus</i>	Hyracodontidae
sciuravid sp.*	<i>Prothyracodon</i>
Eomyidae	? <i>Epitriplopus</i>
eomyid sp.*	Amynodontidae
Rodentia inc. sed.	<i>Amynodon</i>
1 sp.	Artiodactyla
Carnivora	Dichobunidae
Limnocyonidae	? <i>Pentacemylus</i>
? <i>Limnocyon</i>	<i>Apriculus</i> *
Miacidae	? <i>Auxontodon</i>
<i>Miacis</i>	? <i>Hylomeryx</i>
<i>Tapocyon</i>	Agriochoeridae
Condylarthra	<i>Protoreodon</i>
Hyopsodontidae	<i>Diplobunops</i>
<i>Hyopsodus</i>	Leptomerycidae
Perissodactyla	<i>Leptotragulus</i>
Equidae	<i>Leptoreodon</i>
<i>Ephippus</i>	Oromerycidae
	<i>Malaquiferus</i> *

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\*Indicates this is the first record for the taxon in the late Eocene.

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PALEONTOLOGY AND GEOLOGY OF THE BADWATER  
CREEK AREA, CENTRAL WYOMING

## Part 2. The Badwater Multituberculate

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This is the second in a series of papers concerned in part with the Badwater local fauna, of late Eocene age, from the Hendry Ranch Member of the Tepee Trail Formation of Natrona County, Wyoming. The author would like to thank Drs. Craig Black and Mary R. Dawson of the Carnegie Museum (CM) and Peter Robinson of the University of Colorado Museum (UCM) for the loan of specimens and for the invitation to describe this species. The author would also like to thank Dr. Malcolm C. McKenna and Dr. Black for the opportunity, during the summer of 1965, to observe central Wyoming's early Tertiary mammal localities, including the Badwater area. Studies of Cretaceous and Paleocene multituberculates, which supply the background for this investigation, have been supported by NSF grant GB-2213. The general late Eocene studies which led to the recovery of material described here were supported by NSF grants GB-1266 and GB-4089 to Drs. Black and Dawson. Support for publication was received from the Gulf Oil Corporation and the University of Minnesota.

## INTRODUCTION

The discovery of an ectypodont multituberculate from the Badwater late Eocene (Robinson, *et al.*, 1964) unexpectedly extended the range for a subclass thought to have become extinct in the early Eocene (Jepsen, 1930, 1949). However, considering the variety of multituberculates in the early Eocene Four Mile fauna (McKenna, 1960) and in the Graybullian of the Bighorn Basin (Van Houten, 1945), some range extension might have been anticipated. The question now arises whether this is indeed the latest multituberculate. In view of the extensive studies of Chadronian micromammals in Montana, Wyoming, and South Dakota, I think it unlikely that any multituberculate survived

in those areas at that time. However this is the only adequately surveyed area of this age in the world and the possibility cannot be excluded that multituberculates might have survived elsewhere in post-Uintan time.

## SYSTEMATIC DESCRIPTION

### Family ECTYPODONTIDAE<sup>1</sup>

The family Ectypodontidae (Sloan and Van Valen, 1965) consists of the genera *Cimexomys* Sloan and Van Valen, 1965; *Mesodma* Jepsen, 1940; *Mimetodon* Jepsen, 1940; *Ectypodus* Matthew and Granger, 1921; *Neoplagiaulax* Lemoine, 1882; *Parectypodus* Jepsen, 1930, and three unpublished middle Paleocene genera. Differential diagnoses of *Ectypodus* and *Neoplagiaulax* are included in my completed manuscript on Puercan multituberculates from the San Juan Basin. The manuscript is part of a larger paper on Puercan mammals.

### Genus *Parectypodus* Jepsen, 1930

This genus has had a checkered history. Jepsen (1930) proposed it for a pair of new species from the Graybullian of the Bighorn Basin, *P. simpsoni* and *P. tardus*. In 1940, Jepsen provisionally placed it in the synonymy of *Ectypodus* following a suggestion by Simpson (1937). However, the type of *Parectypodus*, *P. simpsoni*, is not congeneric with *P. tardus*, which is referable to *Ectypodus*. *Parectypodus* is a valid genus that may be defined as follows: Ectypodontidae in which the height of the first serration above the anterior enamel base of  $P_4$  is more than 50 per cent of the standard length of the tooth; the labial height of enamel at the anterior root of  $P_4$  is approximately the same or greater in length than the standard length. The posterior angle between the plane of occlusion of the first molars and the anterior face of  $P_4$  is a right or acute angle, usually the latter. The third or fourth serration of  $P_4$  is highest above the base line for standard length. Known values for the ratio of length of  $P_4$  to length of  $M_1$  are high for ectypodontids (1.8 to 2.0). Advanced species lack  $P_3$  as do advanced species of some other ectypodontid genera. The length of  $P^4$  is about 80 to 85 per cent of the length of  $P_4$  with cusp formulas 2-5:7-9. More external cusps occur in advanced species. The posterior slope of  $P^4$  is short, steep, and slightly concave, the anterior slope convex, the antepenultimate cusp usually highest, and posterior basal cuspule usually absent.

<sup>1</sup> The spelling of this name is here corrected to agree with the derivation of the name *Ectypodus*.

*Parectypodus lovei*<sup>2</sup>, new species

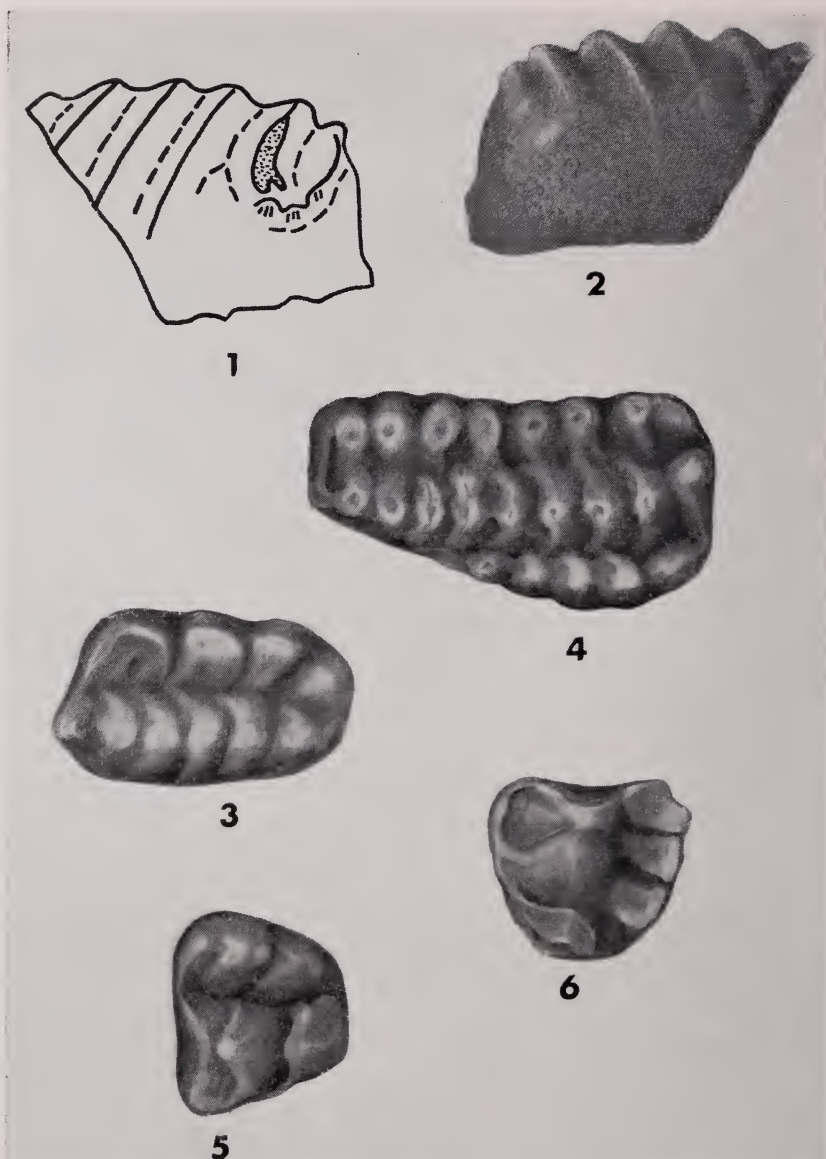
Figures 1 - 6, Table 1

HOLOTYPE: CM 15126, slightly worn right  $M_1$ .HYPODGM:  $M_1$ , CM 15129, CM 16982, CM 16983, and UCM 28359; posterior portions of  $P_4$ , CM 15053, CM 15629, CM 16980, CM 16984, and UCM 28358;  $M^1$ , CM 15084, CM 15085, CM 15133, CM 16981, UCM 25681, UCM 27076, UCM 27096, and UCM 28360;  $M^2$ , CM 15054, CM 15086, UCM 25255, and UCM 27094.GEOLOGIC AGE AND LOCALITY: Uintan, late Eocene; Hendry Ranch Member, Tepee Trail Formation; locality 5 (Tourtelot, 1957) SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 13, T. 39 N., R. 89 W., and 5A, NW $\frac{1}{4}$ sec. 24, T. 39 N., R. 89 W., Natrona County, Wyoming.DIAGNOSIS: Small, size near that of *Parectypodus sinclairi*. Length: width,  $M_1$ , 1.6:0.9 mm., cusp formula 6:4. Length: width,  $M^1$ , 2.15:1.1 mm., cusp formula 8:10:6. Length: width,  $M^2$ , 0.95:1.0 mm., cusp formula 1:3:3. Estimated ratio, length  $P_4$  to length  $M_1$ , 2.1.

DESCRIPTION AND DISCUSSION: Since no complete specimens of  $P_4$  and none of  $P^4$  are known for *Parectypodus lovei*, assignment of this new species might be questioned. The five partial specimens of  $P_4$  are essentially all half teeth with the break occurring at the midpoint, just posterior to the large labial enamel expansion sheathing the anterior root. This is the usual place for a break in  $P_4$ . The partial  $P_4$  specimens are slightly longer than the complete  $M_1$  and the estimated  $P_4/M_1$  ratio is 2.1. Of known ectypodontids, only *Neoplagiaulax macrotomeus* and the species of *Parectypodus* have the corresponding ratio near this value. In addition, the proportions of relative height of the posterior halves of  $P_4$  are those of *Parectypodus* and so is the shape of the postero-labial cuspule and the associated minor sculpture (figs. 1,2). On the basis of the spacing of serrations, I would estimate the total number of serrations as  $12 \pm 1$ ; which is reasonable for a small ectypodontid.

$M_1$  is represented by five specimens in varying stages of wear. The length to width ratio is 1.7. This is rather low for an advanced ectypodontid and in fact no other post-Campanian ectypodontid I know has a ratio quite this low. It resembles University of California Museum of Paleontology (UCMP) 44009 from the Four Mile Fauna (McKenna, 1960, fig. 13c) rather closely. The cusp formula is 6:4 or 5, with 4 being the usual number of cusps in the internal row (fig. 3). CM 16983 has an incipiently bifid posterior internal cusp, and in CM 15129 this cusp has split. All cusps are crescentic. In comparison to the other internal cusps, the antero-internal cusp is displaced toward the midline of the tooth.

<sup>2</sup> For Dr. J. D. Love of the United States Geological Survey, whose studies of early Tertiary stratigraphy of Wyoming have greatly benefited vertebrate paleontology.



Figs. 1-6. Teeth of *Parectypodus lovei* x25. Fig. 1. CM 15053, fragmentary left  $P_1$ , labial view. Solid lines, outline or crest; stippled area, wear facet; dashed lines, troughs or centerline of depression. Fig. 2. CM 15053, fragmentary left  $P_1$ , lingual view. Fig. 3. CM 15126, right  $M_1$ , type specimen. Fig. 4. UCM 25681, left  $M^1$ . Fig. 5. CM 15086, right  $M^2$ . Fig. 6. CM 15054, worn right  $M^2$ .



No specimens of  $M_2$  or of upper premolars have been recovered.

$M^1$  is represented by eight specimens, only one of which (UCM 25681, fig. 4; also figured in Robinson, *et al.*, 1964) is complete enough to provide length measurements or complete cusp formulas. Two other specimens are sufficiently complete to count the cusps on the internal row. The cusp formula of *P. lovei* is 8:10:5 or 6, which is about as close to the formula of *Parectypodus laytoni* (9:9:5) as to anything else. *P. lovei* and *P. laytoni* are the only species of *Parectypodus* in which this formula is known. The cusps of the middle row are significantly larger than the cusps of the other rows and have strongly crescentic lateral crests directed forward. The cusps in the posterior half of the external row have two medially directed crests each. The tooth is obliquely curved in the occlusal plane.

Four examples of  $M^2$  are at hand. All are somewhat worn and have cusp formulas of 1:3:3 (figs. 5, 6). The external cusp is a swelling on a crest extending laterally from the external wing of the antero-medial cusp and then posteriorly to the external wing of the central cusp of the middle row. The central cusp of the middle row dominates the entire tooth, as in *P. laytoni*, the only other species of the genus for which this tooth is known. The anterior cusp of the middle row is a short transverse crescent. The cusps of the internal row decrease in size posteriorly and are subcrescentic.

On the basis of wear, right or left side, and number of specimens of types of teeth from three sub-localities, the 22 specimens at hand represent a minimum of six individuals.

The present species seems quite clearly to be derived from *Parectypodus laytoni* by way of the undefined species of *Parectypodus* from the early Eocene Four Mile fauna (McKenna, 1960, fig. 13b, UCMP 44010 and perhaps also UCMP 44009 and nine additional American Museum of Natural History specimens).



TABLE 1

		Length (mm.)	Width (mm.)	Cusp formula
M <sub>1</sub>	CM 15126	1.45	.89	6:4
	CM 15129	1.58	.92	6:5
	CM 16982	—	.85	—
	CM 16983	1.63	.89	6:4
	UCM 28359	1.60	.92	6:4
M <sup>1</sup>	CM 15084	—	1.16	??:6
	CM 15085	—	1.05	—
	CM 15133	—	1.07	—
	CM 16981	—	1.02	??:6
	UCM 25681	2.15	1.05	8:10:5
	UCM 28360	—	1.20	??:4+
M <sup>2</sup>	CM 15054	.95	1.05	1:3:3
	CM 15086	.89	1.00	1:3:3
	UCM 25255	.92	1.00	1:3:3
	UCM 27094	1.00	1.05	1:3:3

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PALEONTOLOGY AND GEOLOGY OF THE BADWATER  
CREEK AREA, CENTRAL WYOMINGPart 3. Late Eocene Apatemyidae (Mammalia; Insectivora)  
from the Badwater Area

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The Family Apatemyidae has a widespread distribution in North America from the middle Paleocene to middle Oligocene. Numerically the specimens of *Apatemys* are never abundant even though the family is usually represented in all well sampled faunas. This is true of the Badwater collections; indeed *Apatemys* is less abundant than the multituberculates whose last recorded occurrence is in the Badwater faunas (Sloan, 1966).

The following abbreviations are used: CM, Carnegie Museum; LACM-CIT, Los Angeles County Museum, California Institute of Technology; UCM, University of Colorado Museum; M (with sub- or superscript), molar; P, premolar; L, length; W, width; tr., trigonid; tal., talonid.

## SYSTEMATIC REVIEW

Order Insectivora, *incertae sedis*

Family APATEMYIDAE

Genus *Apatemys* Marsh 1872

Two species of *Apatemys* are found at Badwater; both are also present in the Green River Formation collections of the Carnegie Museum. These species are differentiated on a size basis only as the morphology of the teeth is variable within any size grouping, particularly in the development of the anterolingual cusp (paraconid, according to Gazin 1958, but I question the homology) of  $M_1$ . This cusp may be completely absent or very small. The morphology of the trigonids on  $M_{2-3}$  is not greatly different from that of  $M_1$  and I suspect that the prominent large anterior cusp of  $M_1$  may be the paraconid. In specimens with well developed trigonids, such as the type of *Apatemys downsi*, LACM-CIT 5202, one can develop an argument for either of the anterior cusps

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being the paraconid. Many of the teeth from Badwater not only have poor development of the anterolingual cusp in  $M_1$  but equally poor development of the anterobuccal cusp in  $M_2$ . As the sample is so small the best criteria for species separation seems to be size.

*Apatemys hendryi*<sup>1</sup>, new species

Figure 1

TYPE: CM 15737, left  $M_3$ , from locality 5A.

REFERRED MATERIAL:  $M_1$ , UCM 26458, UCM 23156;  $M_2$ , UCM 26026;  $M_3$ , Type and CM 15744, CM 15639, all from locality 5A, and CM 13313,  $M_1$  from the Green River formation of Utah.

KNOWN STRATIGRAPHIC AND GEOGRAPHIC RANGE: Lower Bridgerian of Powder Wash, Green River Formation, NE Utah and Uintan (?) of the Hendry Ranch Member, Tepee Trail Formation, Wind River Basin, Wyoming.

DIAGNOSIS: Approximately three-fourths the size of *Apatemys bellulus*, Marsh.

DISCUSSION: Study of the measurements of *Apatemys* shows that the maximum width of the lower molars varies from trigonid to talonid on different teeth. Gazin's (1958:89) listing of the maximum tooth widths, therefore, does not distinguish which part of the tooth was actually wider. As some of the width differences are sizable, study of a significantly large sample of *Apatemys* might allow for greater precision in species recognition if relative trigonid-talonid widths are accounted for. It is unfortunate that we do not have any jaw material of *Apatemys* from the Badwater localities, as such material would offer some insight into the relationships. However, one can assume that the jaws when found will be similar to other *Apatemys* jaws and will be disproportionately deep.

The recognition of such a small *Apatemys* as *A. hendryi* is certainly due to the method of collection of both the Green River and Badwater faunas. I doubt if isolated teeth of such a small animal would ever be found by normal collecting methods.

*Apatemys* sp. cf. *A. bellus* Marsh 1872

REFERRED MATERIAL:  $M_1$ , CM 15679;  $M_2$ , CM 15021, UCM 28354 (trigonid only).

LOCALITIES: CM 15679, CM 15021, both from locality 5-front, UCM 28354 from locality 5A.

<sup>1</sup> Named in honor of James Hendry of Lost Cabin, Wyoming, in appreciation for his kindnesses to the several field parties that have worked on his ranch.





Figure 1. Crown view of LM<sub>3</sub>, *Apatemys hendryi*, type, CM 15737, x 66; light from upper right.

DISCUSSION: Very little can be added to Gazin's recent (1958) review of this species except to note that the trigonid cusps of the molars of *Apatemys* sp. cf. *A. bellus* are usually more distinct than those of *A. hendryi*.

The lack of the smaller *Apatemys* at locality 5-front may be significant as the rarer large species is present here. Even though the total sample of *Apatemys* is small, the total sample of teeth is large and the probability of missing *A. hendryi* at locality 5-front would be slight.

MEASUREMENTS IN MILLIMETERS OF *Apatemys*  
TEETH FROM UTAH AND WYOMING

Specimen	M <sub>1</sub>			M <sub>2</sub>			M <sub>3</sub>			Locality
	W tr.	W tal.	L	W tr.	W tal.	L	W tr.	W tal.	L	
UCM 23156	0.83	0.94	1.48	—	—	—	—	—	—	5A
UCM 26458	0.80	1.05	1.72	—	—	—	—	—	—	5A
CM 13313	0.70	0.94	1.35	—	—	—	—	—	—	Powder Wash
UCM 26026	—	—	—	0.92	0.92	1.47	—	—	—	5A
UCM 28354	—	—	—	1.47	—	—	—	—	—	5A
CM 15021	—	—	—	1.54	1.19	2.45	—	—	—	5-front
CM 15679	1.05	1.33	1.72	—	—	—	—	—	—	5-front
CM 15737*	—	—	—	—	—	—	0.88	0.74	1.50	5A
CM 15744	—	—	—	—	—	—	0.87	0.95	1.73	5A
CM 15639	—	—	—	—	—	—	0.95	0.75	1.51	5A

\* Type *A. hendryi*

*Apatemys* sp.

A single upper molar of *Apatemys*, CM 15740, from locality 5A, has been recovered. The upper dentition of *Apatemys* has only recently been figured (McKenna, 1963) and the middle Eocene (Bridger and Green River formation samples) have yet to be studied. Species assign-

ment might be made here on a size basis as with the lower teeth, but as the lower teeth are so variable, the uppers probably are variable as well. I therefore do not assign this tooth to a species; it is generally small and is probably not in the size range of *A. rodens* or *A. downsi*.

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